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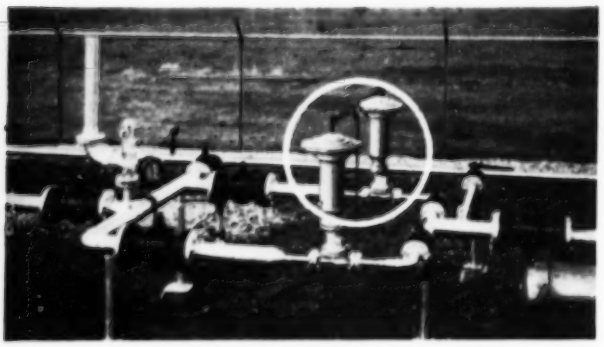

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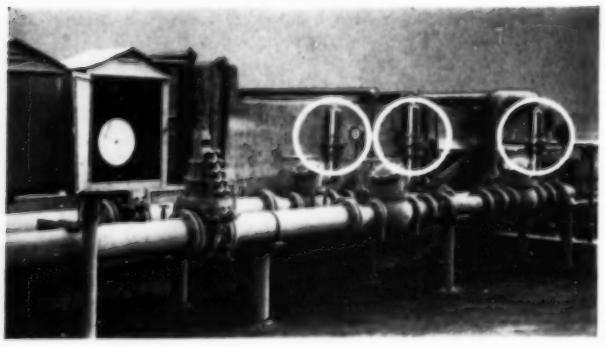

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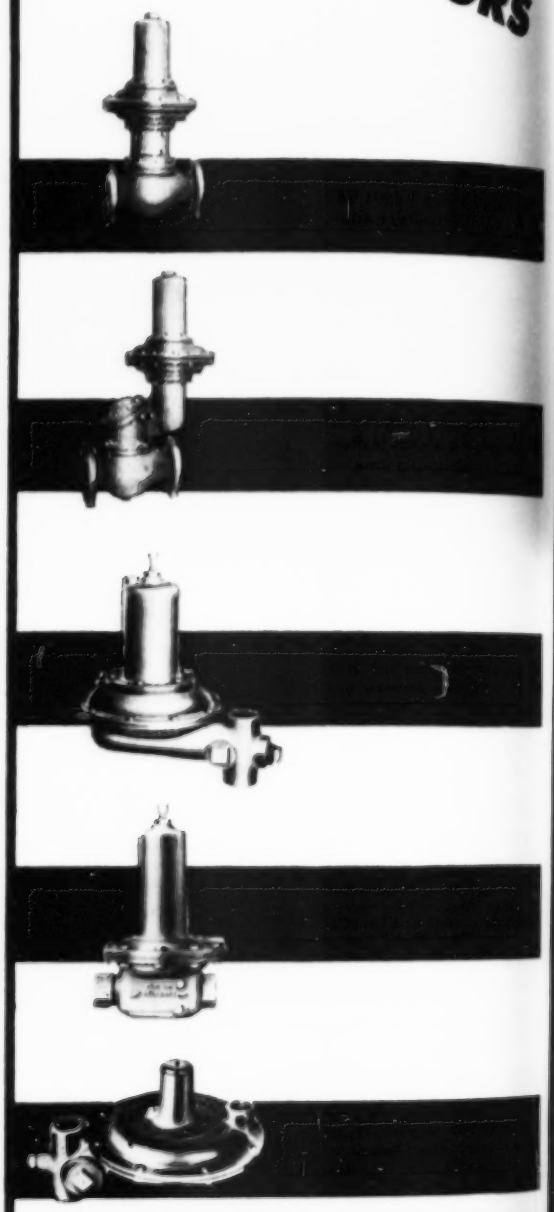

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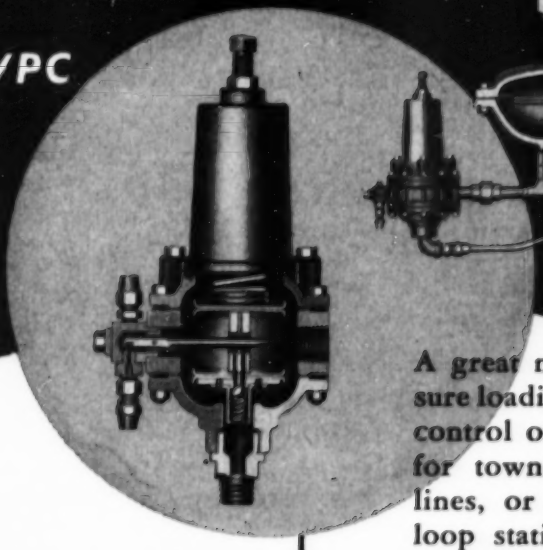

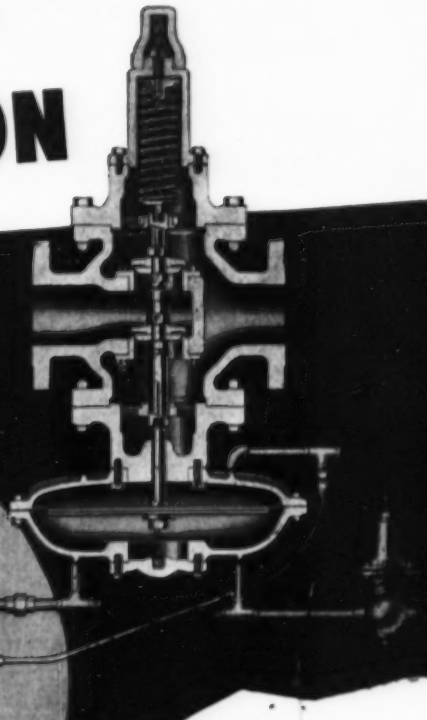

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IN THIS ISSUE . . . .

The 1955 edition of the annual GAS survey of construction budgets—the most complete of its kind—shows that 178 major companies will spend $1.2 billions (see pages 37-43), including $811 millions for transmission jobs (see pages 130-135 for annual pipeline progress maps). . . . Compressor station maintenance is good business and tips on methods of scheduling preventive maintenance are told on page 137 and those following. . . .

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GAS Thermally Thinking

Who's got the bucks?

As noted elsewhere in this issue (page 82), the recent annual business meeting of the New England Gas Association in Boston offered more than a normal complement of provocative messages. New Englanders as a group are pretty unhappy about the natural gas pricing situation, and while (being pretty far-right conservatives) we can't agree with their solution to the dilemma, we can certainly sympathize. Sympathy, of course, isn't going to retire any bonds—except maybe sympathy from the right quarters, backed up by action.

And while the tail-end (of the pipelines) Charlies in the utility business are having their beefs, the appliance manufacturers have their own beefs against the utilities. As GAMA's Tom Arden pointed out, profits for manufacturers have slipped badly. Five gas range manufacturers who collectively did $145 million worth of business in 1953 racked up an average of only 4.3%—*before taxes*. But even that was a good record compared to '54, when gross business totaled $103 million and profits slipped to 2.3%, also before taxes. Thus in one of the most prosperous periods in history, executives of certain *unregulated* businesses might well wish they could be carrying on a good, substantial utility-type business where the profits sometimes soar to 5 or 6%! And these same manufacturers are serving an industry where fuel demand continues to exceed supply (but where utilities are worried about the possibility of wholesalers pricing them out of the market)! How goofy can you get?

Here's another anomaly: What's been one of the most glamorous and romantic achievements of the past decade? Why, long-distance natural gas pipelines. Long-distance electric transmission lines can't hold a candle. But when you get to the appliance that puts the energy to work, which twin has the glamour? She's the electric girl—the Cadillac of the range world, if you will. She is more expensive, so she's more desirable. Says Tom Arden, citing the comparative average retail prices on ranges of $170 for gas and $255 for electric, on water heaters of $80 vs $132:

"The electric appliance industry holds a very substantial advantage for the simple but strange reason that electric appliances command substantially higher retail prices.

"Can it be that we are so burdened with inferiority complexes as to believe we must substantially undersell the electric appliance? Or have we through almost suicidal practices allowed pricing structures of appliances to deteriorate to the point where not only do the manufacturers net almost no return for their effort, but perhaps the general public gets the idea that gas may actually be inferior merely because it's much cheaper?"

Sorta looks that way. But no matter what psychological tag might be attached to the present state of customer acceptance, the problem goes back to the same old diagnosis: not enough selling. And mainly that means not enough dollars in the advertising-promotion kitty. And who's got the bucks? Pipeline companies, for one. As AGA President Banks not too subtly remarked at Boston, "We even hope that some of the pipeline companies will see their way clear to supporting PAR over and beyond the pipeline research portion of the program."

He could have also mentioned the producers. They're the ones who are doing the best job of overlooking about the most basic economic fact of life: if you want to sell it, you have to advertise it and promote it. It's as simple as that.

And if the producers should once again be made regulation-proof, there's where your biggest single source of bucks will be.

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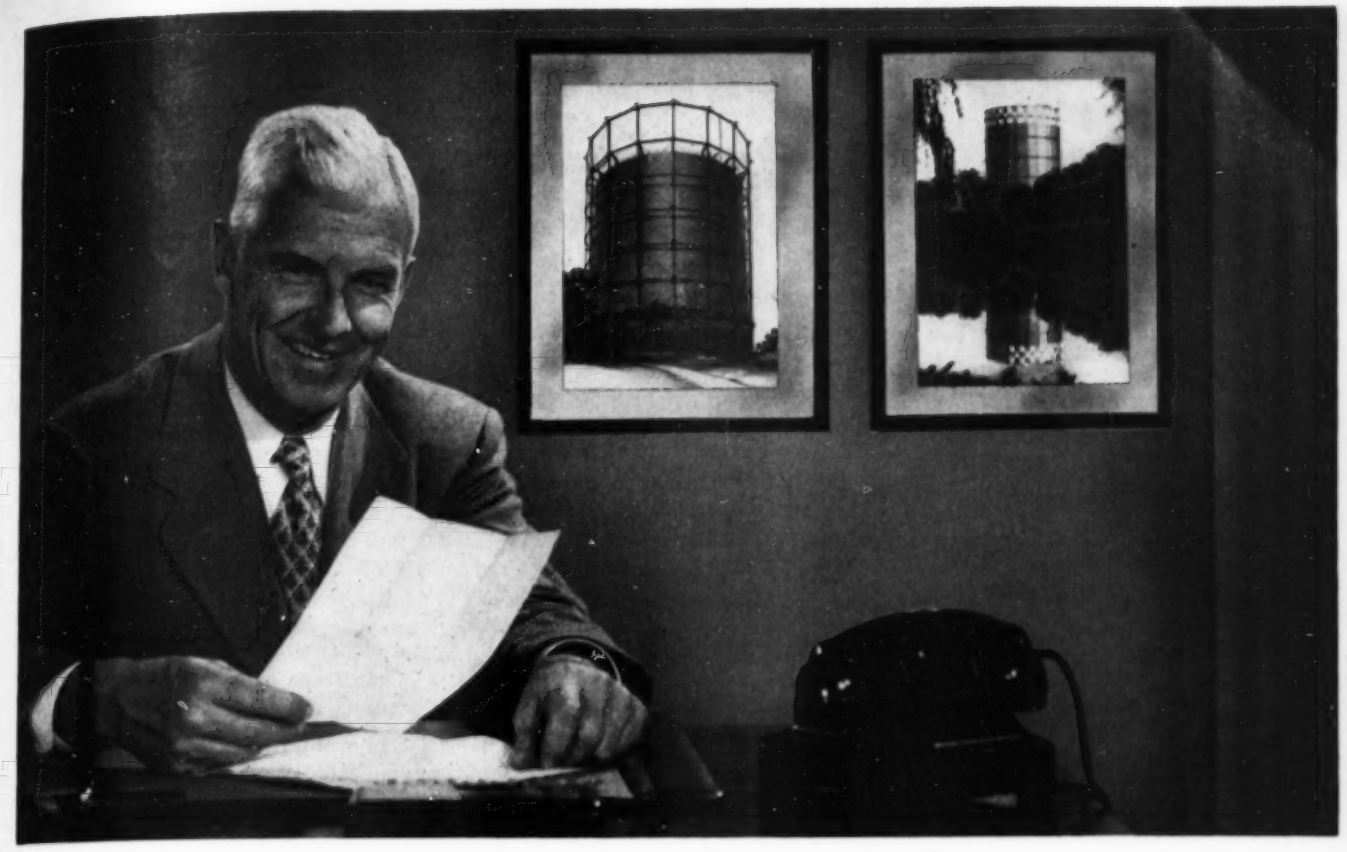

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highlights

GAS SPOT NEWS, TRENDS, COMMENT ON GAS INDUSTRY AFFAIRS

Canadian gas matters bouncing again

The latest odds on Trans-Canada's pipeline are that it won't be built this year—perhaps not at all. It never was too economic: the government plumped for an "All-Canada" line, thus bypassing some good U. S. markets in favor of a route through the wilderness. When hard-headed financiers balked and the government talked about subsidizing the line—or underwriting it—Canadian Gulf refused to sell gas to Trans-Canada for fear of government meddling. Alternative plans for serving eastern Canada are being dusted off; however, Westcoast Transmission Co., which has filed an application with the Canadian parliament to extend its operations under its present charter from Alberta and B.C. to the additional provinces of Manitoba, Saskatchewan, Ontario, and Quebec, denies that it has any designs on the market areas. Westcoast says the reason for this provision in the filing, which also seeks an increase in capitalization, is that the company "would like to be able to pick up gas in provinces other than Alberta and British Columbia, if at some time in the future there might be a surplus in these areas."

Westcoast is "concentrating on Pacific Coast markets"

Plans are already being studied for a second natural gas line out of northwestern Alberta and northeastern B.C.—a 30-in. line following the same general route as the initial line, except that at the lower end it would veer eastward to an export point at Osoyoos at the southern end of the Okanagan valley. Westcoast expects both markets and reserves to grow rapidly.

On this side of the border, conversion contract to be let

Seattle Gas Co. was about ready to award a $250,000 main construction contract in anticipation of 1956 arrival of natural gas from Pacific Northwest Pipeline Co. Pacific appeared to have cleared its last hurdle—opposition of Trans-Northwest Gas Co.—when the third Circuit Court of Appeals dismissed the latter's petition for a setting aside of Pacific's certificate. Pacific will buy some of Trans-Northwest's assets. Meanwhile, Cascade Natural Gas Corp., which was the outgrowth of a merger of several distributing companies, announced purchase of Consolidated Gas Co., serving six Yakima valley communities.

Hoover Commission urges new FPC legal procedures

Along with other government commissions, FPC would lose control of its hearing examiners, who would become "hearing commissioners" with all the authority and responsibility of trial judges, and be under control of a central chief hearing commissioner, according to latest Hoover Commission suggestions. Tightening of procedures and formality was also recommended as a means of streamlining agency proceedings. The Hoover task force proposed the formation of a new administrative court, with three sections dealing with adjudicative phases of labor, tax, and trade regulation. "As a further step toward taking from other administrative and regulatory agencies the power to be arbiters of their own decisions (the report suggests), that the Congress study the feasibility of transferring to existing courts of general jurisdiction certain judicial functions of these agencies such as the imposition, remission, or compromise of money penalties, awarding of reparations or damages, and issuance of injunctive orders. . . ."

Supreme Court decision voids Oklahoma minimum price law

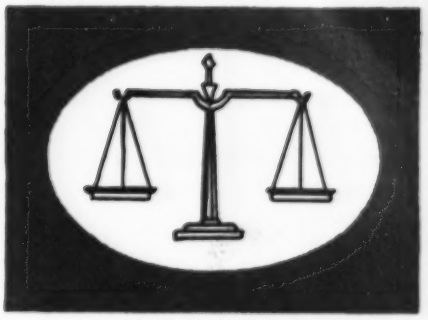
Its previous decisions on state-fixed wellhead minimum prices dealt "only with constitutional questions and not the construction of the Natural Gas Act," the Supreme Court held in reversing a lower court decision which had upheld the Oklahoma Corporation Commission's order. "The Phillips case controls this one," declared the court. Incidentally, the latest word was that the Texas legislature's "economic waste" bill is about dead (see page 158).

Quick windup of Harris-Hinshaw hearings sought

Chairman Percy Priest of the House Interstate and Foreign Commerce Committee wanted to close out hearings on the Natural Gas Act bills by May 1. Following the Easter recess, the committee reconvened to hear the bills' opponents. That included everybody from distributing utilities, some of which favor strict modifications of escalator and favored nation's clauses, to coalmen, miners, and the coalition of municipal pressure groups in the North and Northeast.

*regulatory and legislative trends

Federal legislationitis



MORE persons have more at stake in the proposed legislation to exempt gas producers from Federal price regulation than in any other pending legislation. More than 5000 independent gas producers, the nation's sixth largest industry—natural gas—with its $14 billion investment, and 25 million gas users have an interest in this legislation.

The Harris-Hinshaw bills have received potent support in the house committee hearings. Those bills were drafted to implement the recommendation of the President's Cabinet Committee on "Energy Supplies and Resources Policy." That recommendation, which was made on March 4, 1955, was:

Sound conservation

"In the production of natural gas it is important that sound conservation practices be continued. This area of conservation management is under the jurisdiction of state conservation commissions. In the interest of a sound fuels policy and the protection of the national defense and consumer interests by assuring such a continued exploration for and development of adequate reserves as to provide an adequate supply of natural gas, we believe the federal government should not control the production, gathering, processing, or sale of natural gas prior to its entry into a transmission line .

"The interstate transmission of natural gas by the interstate transmission lines and the subsequent sale of such gas for resale is a public utility function and should be under the regulation of the Federal Power Commission. In considering the certification of new lines and applications for increased rates based on new lines and application for increased rates based on new or renegotiated purchase contracts, the commission should consider, in order to provide protection for the consumer, not only the assurance of supply but also whether the contract prices of the natural gas which the applicant has contracted to buy are competitively arrived at and represent the reasonable market field price, giving due consideration, in in the interest of competition, to the reasonableness and appropriateness of contract provisions as they relate to existing or future market field prices."

Chairman Kuykendall, testifying for the Federal Power Commission majority before the house committee, made a vigorous and comprehensive statement supporting exemption of independent gas producers from Federal regulation. His declaration was a brilliant advocacy of our free choice system, which provides incentives to private endeavor. He asserted that, from every aspect of public interest and particularly of national defense, Congress should not single out natural gas as the only one of the fossil fuels upon which an artificial price ceiling should be imposed.

No incentive

Commissioner Kuykendall was bold to say that public utility regulation has never been able to supply the incentive for economy which competition provides in unregulated industries. He added that:

"Before all the advantages of competition are discarded, it should be definitely ascertained that competition in the natural gas industry is inadequate, and connot be made adequate by any legal means. We are of the opinion that the gas producing industry does not have the characteristics of public utilities which must and should be monopolies, and is the type of industry in which competition may flourish, and that any lack of competition or any unfair competition, if any, should and can be dealt with by proper application of our antitrust laws."

The FPC majority visualizes more natural gas for utility customers when producers are returned to the field of competition. The chairman continued by stating that:

"There is good reason to believe, however, that even prior to the *Phillips* decision, large amounts of natural gas chiefly produced by oil companies in conjunction with their production of oil, their primary interest, had been withheld from the market served by interstate commerce and at the same time, as has been indicated, provide sufficient restraint upon the price of such gas as to eliminate the danger of exhorbitant rates. In fact the release of such gas would itself, we believe, act in great measure as such a restraint."

Industrial movement

He asserted that "the availability of large quantities of gas which have been withheld by the producers from interstate markets because of the threat of that type of limitation on prices has resulted, and will, we believe, continue to result in the establishment in the areas where natural gas is produced, in preference to other areas, of petro-chemical and other plants using large volumes of natural gas, as well as the movement of industries from points outside of and remote from them into areas in which such intrastate gas is available. It is certainly not beyond the bounds of reason that, without some legislation such as that here proposed, remote domestic and other natural gas consumers may find themselves facing, not only a

*A monthly commentary on national and state developments by an expert in the field of utility law.

Regulatory trends... French Robinson represented the utility viewpoint

diminishing supply of such gas, but the fact that some of the industries upon which the economy of their communities depend may have removed from their midst."

The FPC chairman agreed with Ernest Thompson of the Texas Railroad Commission that the fixing of the price charged by producers for gas sold in interstate commerce will result in conflict with the recognized power of each state to regulate gas producers for conservation purposes.

Chairman Kuykendall concluded for FPC by using insight and foresight. He said that, "a sound fuel policy is essential to a robust and expanding internal economy and to the successful development of the national defense. We believe that no sound fuel policy can be erected upon such discrimination as presently exists against natural gas and in favor of other competitive fuels. We believe further that such a policy requires the exploration and development of our oil and natural gas resources against a background of free competitive enterprise, restricted only by appropriate state conservation regulation. Consequently, we believe that the federal government should not undertake the control of the regulation of rates of those engaged in the production, gathering, processing or the selling of natural gas prior to its entry into an interstate transmission pipeline; and that the Natural Gas Act should be amended accordingly."

Persuasive opponent

One persuasive opponent of the Harris-Hinshaw amendment to the Natural Gas Act was J. French Robinson, president of the Consolidated Natural Gas Co. The Consolidated system renders gas service to more than a million retail customers in Ohio, Pennsylvania, and West Virginia. Mr. Robinson testified that the proposed bill would accomplish these results:

"(1) free the producers from all regulation under the Natural Gas Act;

(2) preserve existing and future contracts made by producers, whatever their terms, and whether or not they may be harmful to the public interest;

(3) give partial protection to the interest of consumers and the public by providing that as to all 'new and renegotiated' contracts the consumer shall pay only a reasonable market price, thereby causing the pipeline to stand in the middle and absorb any difference between the price under the contract and the market price which is allowed by the commission; and

(4) guarantee that those pipeline companies which own their own production shall receive the equivalent of a reasonable market price for their own production."

Mr. Robinson objected to the bill and recommended that it be changed because "it does not deal with the fundamental problem caused by favored-nation and escalation clauses which have become prevalent in producer contracts and which definitely appear to be against the public interest."

The problem of the distribution company was emphasized by Mr. Robinson, who said that:

"The numerous and recurring increases in field prices and pipeline rates have had a most disrupting effect on normal utility rate problems, where stability of rates is highly desirable. If the increases are continued, there can be a serious breakdown in utility rates and service." He declared that, "The retail price for gas is now reaching competitive levels in our industrial markets, following increases averaging 32% since 1939. Industrial sales, which in our system are on a firm year-round basis subject to interruption by weather emergencies only, represented 28% of our total sales in 1954. These sales would be greatly reduced if the price for gas were to go above the competitive price for oil and any such reduction in sales volume would disrupt the careful balance which must be maintained between residential and industrial sales. Any reduction in industrial sales would result in an immediate increase in domestic rates." He said that, "Our companies are obligated to buy tremendous quantities of gas under fixed long-term contracts which contain minimum 'take-or-pay' obligations. We must be able to market this gas and we are vitally concerned over the increasing price of gas in the Southwest gas fields."

Mr. Robinson's solution is that, "Congress must either leave the Natural Gas Act as it now stands or must provide for exemption of producers only on condition that their method of selling gas to pipeline companies is accomplished in a form and manner which conforms to public policy as set forth in a legislative standard." This gas distributor concluded by stating that, "We believe that it would be a serious mistake and a violation of the public interest for Congress now to amend the statute so as to grant the producers an exemption without at the same time establishing a proper policy as to methods of sale by producers and thereby providing against the unrestrained action of favored-nation and other escalator clauses."

The opponents of this legislation to exempt producers are expected to sponsor witnesses, who are mayors, governors and others claiming to represent the interests of consumers. It is predicted that the house committee hearings will be completed during May.

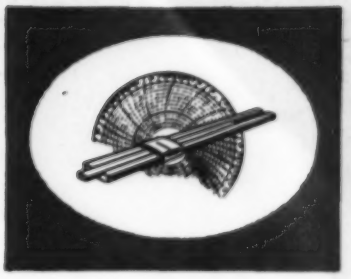
We know what the producers think, we have reviewed the regulatory commission's philosophy, and have scrutinized the testimony of a large local gas distributor, but what do the managers of long-distance pipeline companies think?

Stubborn facts

Paul Kayser, president of El Paso Natural Gas Co., which delivers 2 billion cu ft of gas daily to markets in Texas, New Mexico, Arizona, Nevada, and California, has been eloquent on this issue. He states stubborn facts, such as: the nation depends upon oil and gas for 64% of its energy resources; the supplies of oil and gas are wholly dependent upon exploration and discovery; oil reserves now have an indicated 13 years' supply; and gas reserves have declined from a 30 years' supply in 1947 to a present 23 years' indicated supply.

Mr. Kayser contends that federal regulation of gas producers is injurious to the economy, because (1) it will restrict exploration and reduce the quantity of gas available for consumers' requirements, (2) it will lead to regulation of the other competing fuels—oil and coal, as well as other commodities like lumber, wheat and cotton, (3) it further centralizes power in the federal government and will nullify conservation regulation by the states, (4) it is a socialistic measures grasping far beyond utility regulation. ■

technical trends



• By GUY CORFIELD

Our new patent law

Our new patent law is actually a little more than two years old, but this is relatively new when the history of the Patent Office is reviewed, and when it is considered that it necessarily takes a long time to interpret and understand rather sweeping changes in such a complicated law. The U. S. Patent Office is a venerable organization, being first established in 1790 and attaining the status of a separate bureau in 1802. There were general revisions in 1831 and 1870, and since the latter date numerous acts have been passed by Congress; and on Jan. 1, 1953 a new revision, Public Law 593, was enacted.

This latest revision has been designed to simplify patent procedures and make it easier for an inventor of a worthwhile contribution to society to secure a patent and obtain enforcement in the courts. To assist in its interpretation the Patent Office provides a "Rules of Practice" dated Jan. 1, 1953 but amended to March 3, 1954, which can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 50 cents. A few of the provisions of interest to technical people are as follows:

The inventor himself must sign the application for patent (as was formerly the case) but if he refuses or cannot be located, a party to whom he agreed in writing to assign the invention may file the application. Likewise, in the case of joint inventors, where one refuses to sign or cannot be located, the others may sign and the patent will be issued to them but it will be subject to the rights of the omitted inventor just as if he had signed. This prevents an uncooperative inventor from tying up the rights of associates.

In connection with an application involving several people as inventors, such as one coming out of a laboratory where a number of chemists, engineers and supervisors are involved, there are now provisions for amending an application by removal or addition of names of inventors; this is of assistance when the claims finally desired are not the same as originally sought and cover subject matter suggested by an associate, and helps in getting the correct names on a patent and avoiding delay and complications resulting from having several contributors.

As a matter of definition, an "invention" means a discovery or development of a specific item, while a "process" means an art of method and includes a new use of a known process, machine, manufacture, composition of matter, or material.

It is now clearly stated that a patent is presumed to be valid, and the burden of proof is on an infringer who claims that it is not valid; this has not been clear, and frequently contested, in the past. It is also clearly stated that a patent gives the right to exclude others from making, using or selling the product of the invention, as opposed to the previous statement that the patent granted exclusive right to make, use and vend; this clarifies a popular misconception that anyone can make a patented article for his own use.

The production of anything included in any patent is not necessarily illegal, but an illegal contributory infringer is one who sells a component of a patented machine or composition or sells apparatus or material for a patented process, knowing it to be especially adapted for infringing the patent and not a stable article or commodity of commerce suitable for substantial non-infringing use.

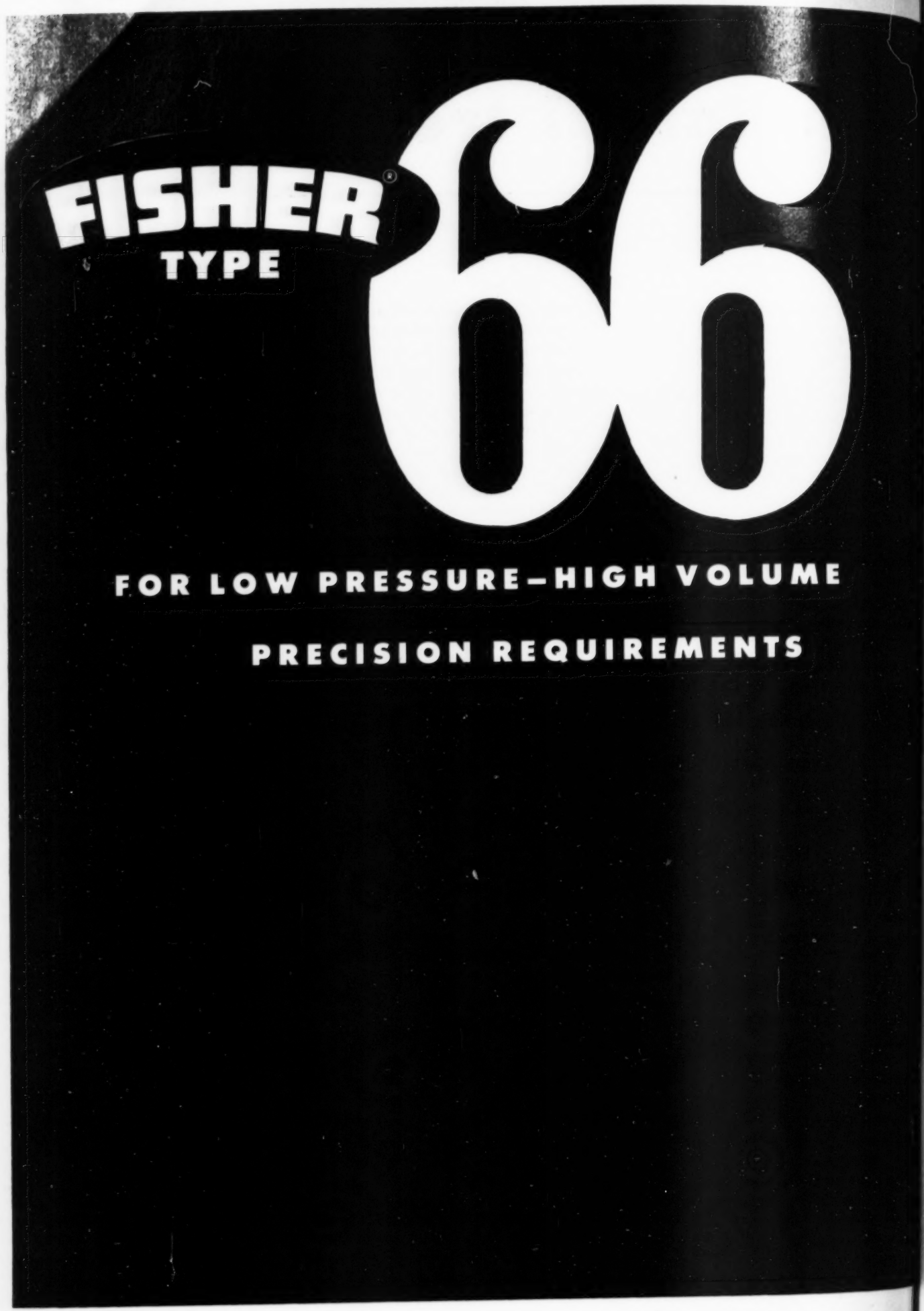
Patented articles should be marked "Pat." or "Patent" together with the number of the patent, or when this cannot be done the package should be so labeled. In the event of failure to so mark, no damages shall be recovered by the patentee except on proof that the infringer was notified of the infringement and continued to infringe, in which event damages may be recovered only for infringement occurring after such notice. Damages cannot be recovered for infringement committed more than six years before filing suit. Penalty for falsely marking an article "Patented" has been changed from $100 minimum to $500 maximum.

Anhydrous ammonia

Anhydrous ammonia, synthesized from hydrogen and atmospheric nitrogen, has become big business in this country and production plants are mushrooming so that supply may actually exceed demand. Capacity as of last Jan. 1 was about 3.5 million short tons per year with firm plans for another 0.9 tons by mid-1956, whereas present domestic consumption is estimated at about 2.7 million tons. It therefore appears that the plants will have to operate below capacity, or find increased outlets by aggressive market development and a probable cut in profits.

Approximately 2.2 million tons are used as agricultural fertilizer, principally applied direct to the ground as liquid either plowed in immediately or added to irrigation water; some is used as ammonium nitrate or sulfate. Industry takes about one-half million tons for synthetic fibers, plastics, explosives, etc.

This development is being watched closely by the gas industry. Formerly a large source of ammonia was from coal distillation, and hydrogen from coke. Then it became profitable to make the hydrogen from thermal cracking of natural gas, and this is the principal and expanding source at the present time. It appears, however, that hydrogen may be increasingly available from oil refinery catalytic reformers, and from heavy residual fuel oil by a newly developed process. It does not seem, therefore, that future ammonia production will have any significant impact on natural gas supplies.


FISHER
TYPE
66
FOR LOW PRESSURE–HIGH VOLUME
PRECISION REQUIREMENTS

1955

Gas Construction to top $1 billion for fifth straight year

TO keep abreast of consumer demand for new service and additional gas for space heating, the gas industry has set up another billion-plus dollar budget for new construction in 1955 . . . the fifth year in a row in which construction budgets have topped the billion-dollar mark.

This year, 178 companies responded to GAS magazine's "Annual Survey of Gas Industry Construction Projects." Of these, 25 were transmission companies, 115 distribution companies, and 38 integrated companies. Together, they have budgeted $1,274,365,000 for new construcion (see *Fig. 1*).

Only the construction budgets of distribution companies included in this total should be projected to the entire industry, for most of the large transmission projects scheduled for 1955 are included in the budgets of companies participating in the survey. A projection of the construction budgets of reporting distribution companies, on the basis of meters in use, indicates that $555.5 million will be spent by all distribution companies in the gas industry. This projected figure, added to the construction budgets of transmission and integrated companies reporting in the survey, would place the total industry-wide new construction figure for 1955 at $1.6 billion (see *Table 1*).

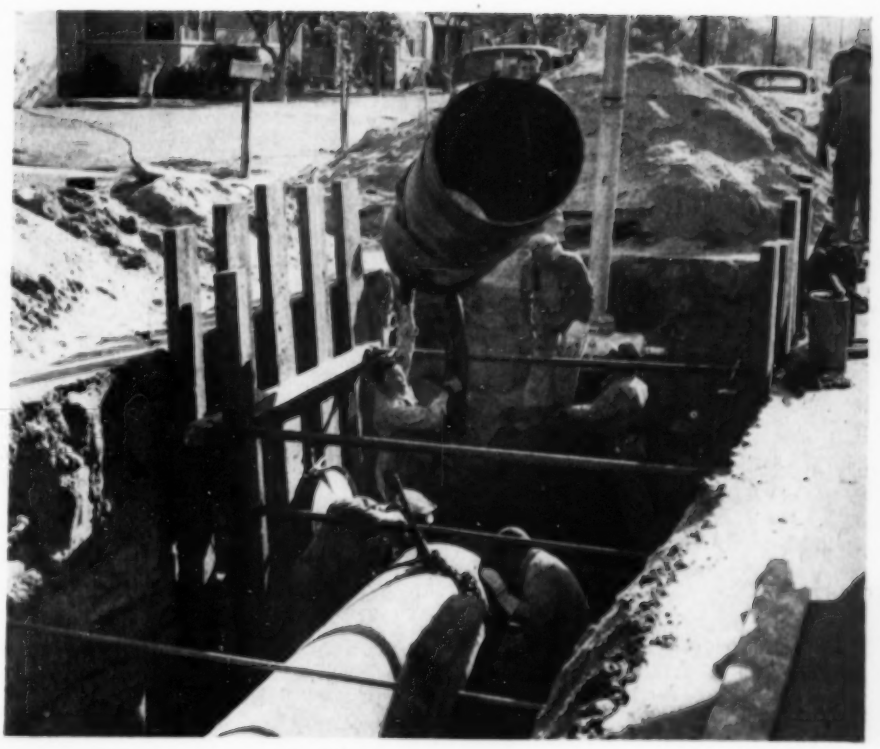
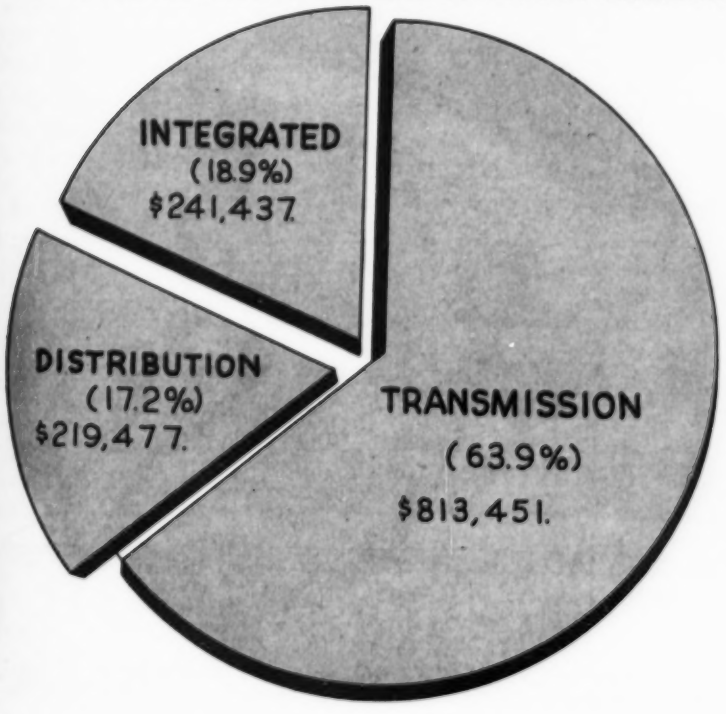


FIG. 1. BREAKDOWN OF BUDGETS BY TYPE OF COMPANY



Comparison

GAS' projection is to be compared with American Gas Association's $1.4 billion estimate of new construction in the gas industry for 1955. The $200 million variance between AGA's estimate and GAS magazine's projection might be due in part to the possibility that distribution companies with sizeable budgets were more likely to an-

swer the GAS questionnaire than those with smaller budgets.

In any event, it seems a certainty that new construction in 1955 will at least run a close second to 1951, the largest construction year in the history of the gas industry (see *Fig. 2*).

TABLE 1. INDUSTRY-WIDE PROJECTION OF BUDGETS OF 178 COMPANIES

	178 Companies	Total Industry
Transmission	$ 813,451,000	$ 813,451,000
Distribution	219,477,000	555,500,000
Integrated	241,437,000	241,437,000
	$1,274,365,000	$1,610,388,000

Transmission is first

A breakdown of 1955 gas industry construction expenditures by types of projects *(Fig. 3)* again this year places transmission far ahead of distribution, production or storage. The fact that both transmission and production budgets are up this year over last means that the gas industry can expect future increases in distribution budgets, for the expansion of the gas industry at one end means its inevitable growth at the other. And as the gas industry continues to grow, so will replacement and maintenance budgets grow.

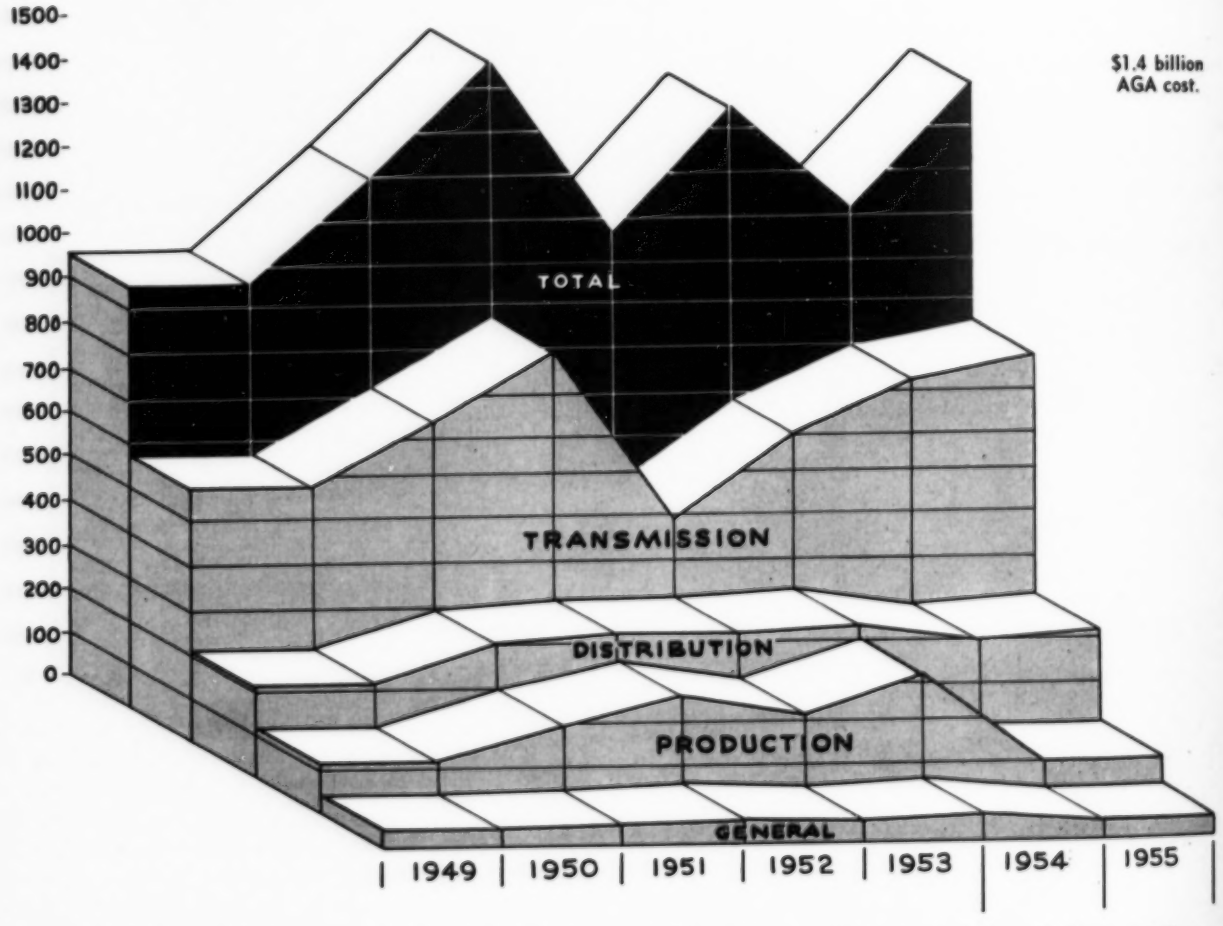
Certain prophets of gloom have been predicting substantial decreases in transmission budgets. While construction of 1000-mile "glamour lines" may be on the ebb, there is still a need for many thousands of miles of loop lines and shorter, smaller-diameter transmission lines.

Construction in the gas industry is established at a high level to keep pace with consumer demand for gas. Growth has been strong and steady, built on a solid background of market study and a knowledge of proved recoverable gas reserves.

* * *

Of the 178 companies reporting in the 1955 survey, 118 also reported in 1954. Most of the larger utilities and transmission companies are included in the group participating both years. This makes possible an interesting comparison in analyzing industry growth. In 1955, these 118 important companies increased their construction budgets by 64%. *Table 2* compares the

FIG. 2. CONSTRUCTION EXPENDITURES BY YEARS



NOTE: The breakdown of expenditures for 1954 and 1955 are estimates based on GAS magazine's Annual Survey of Construction Projects. Storage expenditures are included in "production" through 1953, and in "transmission" in 1954 and 1955.

construction expenditures of the 118 companies, breaking down the total by types of projects.

* * *

The gas industry will build more than 15,000 miles of transmission and distribution lines in 1955, mostly large diameter. These would stretch five times across the United States. In addition to expenditures for pipelines, and production and storage facilities, the 178 companies reporting in the GAS survey will also spend:

- $15 million for administrative buildings.
- Almost $10 million for autos and trucks (this does not include vehicles owned by pipeline contracting firms).
- More than $3.4 million for shops and laboratories.
- $2.6 million for office systems and equipment.
- $2.3 million for communications.
- $10.7 million for unsegregated items.

Projecting these figures to the entire industry would probably more than double them.

* * *

The construction of new transmission lines means the availability of additional supplies of natural gas. This presents expensive conversion problems in areas presently served with manufactured and mixed gas. Consolidated Edison Co. of New York is an example. This company began conversion several years ago. Completion of its program will take about two more years, during which time the company will spend about $27.5 million.

These costs will be amortized over a 10-year period. Included in the project is the adjusting of consumers' gas-burning equipment, and making modifications in the company's distribution system. Additional capital expenditures of about $3.4 million also will be necessary in connection with the changeover. However, savings in the cost of materials, labor, maintenance and pumping are estimated at $4.8 million a year.

At present Consolidated Edison has a 20-year contract for a firm supply of 138.6 MMcf daily of gas from Transcontinental Gas Pipe Line Corp., and 10 MMcf a day from Algonquin Gas Transmission Co. on an emergency basis.

Subject to the Federal Power Commission's approval, the company is proposing to enter into contracts for the receipt of 25 MMcf daily of natural gas from the Tennessee Gas Transmission Co. over a new line at White Plains, and an additional 5 MMcf daily from Transcontinental.

All this represents the type of long range planning that is evident throughout the entire gas industry . . . planning that is based on the fundamental concept that gas is a superior fuel, established as such by an overwhelming consumer demand.

FIG. 3. BREAKDOWN OF BUDGETS BY TYPE OF PROJECT

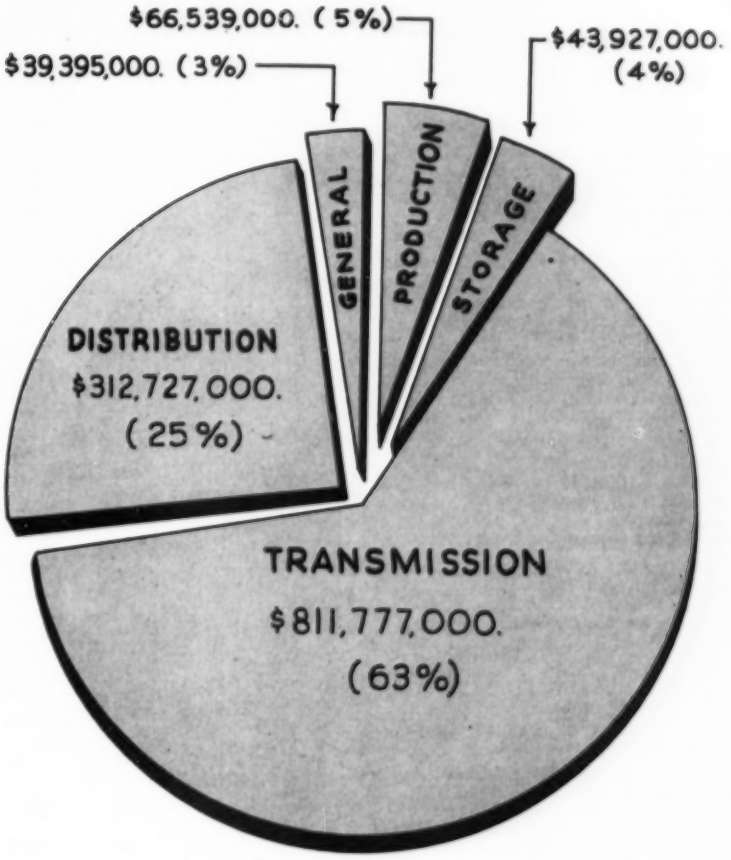


TABLE 2. COMPARISON OF CONSTRUCTION BUDGETS, 1954-55, 118 COMPANIES

Production	$ 30,981,000	$ 53,888,000
Storage	15,082,000	14,090,000
Transmission	183,233,000	370,705,000
Distribution	167,845,000	233,484,000
General	24,363,000	21,405,000
	$421,504,000	$693,572,000

CHANGEOVERS TO NATURAL GAS
(Included in Distribution "Other" Tabulation)

Missouri Public Service Co., Warrensburg, Mo.	$ 17,000
New York State Electric & Gas Corp., Ithaca, N. Y.	60,000
Iowa Electric Light & Power, Cedar Rapids, Iowa	990,000
Public Service Electric & Gas Co., Newark, N. J.	1,300,000
Alabama Gas Corp., Birmingham, Ala.	61,000
Consolidated Edison Co. of New York	27,500,000 (Two years)

ADDITIONS TO LPG STANDBY FACILITIES

Rockland Light & Power Co., Spring Valley, N. Y.	$ 75,000
Central Electric & Gas Co., Lincoln, Neb.	625,000
Northwestern Public Service Co., Huron, S. D.	84,000
Chattanooga Gas Co., Chattanooga, Tenn.	38,000
Manchester Gas Co., Manchester, N. H.	25,000
New Bedford Gas & Edison Light Co., New Bedford, Mass.	100,000
Madison Gas & Electric, Madison, Wis.	21,000
Sierra Pacific Power Co., Reno, Nev.	336,000

1955 building budgets of 177 gas companies

COMPANY	TOTAL	TRANSMISSION						PRODUCTION	
		New Lines	Miles of Line	Repl.	Comp. Sta.	Autos and Trucks	Const. Equip.	Misc.	Plant	Drilling
Alabama Gas Corp., Birmingham	4190									
Alabama-Tennessee Natural Gas Co., Florence, Ala.	620	620	21.2							
Alberta Gas Trunk Line Co., Edmonton, Alta.	37,000		423.8		37,000					
Algonquin Gas Transmission Co., Boston	755			330		40	20	365		
American Louisiana Pipe Line Co., Detroit, Mich.	130,000	130,000	1000.0							
Arkansas-Western Gas Co., Fayetteville	501	23	1.7			8		13		
Arkansas-Missouri Power Co., Blytheville, Ark.	620	225	18.0						34	240
Associated Natural Gas Co., Blytheville, Ark.	285	33	5.0							
Atlantic Seaboard Corp., Charleston, W. Va.	10,749	7936	70.1	355	2152	80		190		
Boston (Mass.) Consolidated Gas Co.	1770								126	
Brooklyn (N. Y.) Borough Gas Co.	277								18	
Brooklyn (N. Y.) Union Gas Co.	3890								200	
Battle Creek (Mich.) Gas Co.	282								16	
Bluefield (W. Va.) Gas Co.	32									
Brockton-Taunton Gas Co., Brockton, Mass.	750									
California-Pacific Utilities Co., San Francisco, Calif.	241	15								
Cambridge (Mass.) Gas Light Co.	507								131	
Carnegie Natural Gas Co., Pittsburgh	335			111	84	30	17			70
Chattanooga (Tenn.) Gas Co.	515								38	
Chicago (Ill.) District Pipeline Co.	2775	2420	16.2			30		325		
Central Illinois Light Co., Peoria	1763								2	
Central Electric & Gas Co., Lincoln, Neb.	2208								625	
Central West Utility Co., Kansas City, Mo.	205			35	8					
City of Springfield, Mo.	675									
Citizens Gas & Coke, Indianapolis, Ind.	3908								115	
Citizens Gas & Fuel Co., Adrian, Mich.	122									
Citizens Gas Co., Hannibal, Mo.	70									
City of Colorado Springs, Colo.	325									
City of Corpus Christi, Gas Division, Texas	478									
Company "A"	243									
Company "B"	9178	87	1.0	427	153			13	2112	1873
Company "C"	2273			104	12				12	
Company "D"	17,280							55	390	
Company "E"	421								150	
Corning (N. Y.) Natural Gas Corp.	313			101						
Connecticut Gas Co. & Conn. Light & Power, Hartford	1303	400		50	4				32	
Consolidated Edison Co. of N. Y.	11,100								2250	
Colorado Interstate Gas Co., Colorado Springs	34,300	19,900	380.0	200	4100	600	200		4800	3100
Consolidated Gas Utility Corp., Oklahoma City, Okla.	1070			100	100	25	10	30	125	
Central Illinois Public Service Co., Springfield	911	345	18.0	51				2		
City of Richmond (Va.) Dept. of Public Utilities	516									
Cincinnati (Ohio) Gas & Electric Co.	3541	522	6.0	153				178	38	
Central Kentucky Natural Gas Co., Charleston, W. Va.	3241	2152	22.0	244	358			32	3	
Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y.	1128	170	4.0	123	105				45	
City of Holyoke (Mass.) Gas & Electric	269									
Concord (N. H.) Natural Gas Corp.	82								2	
Cities Service Gas Co., Oklahoma City, Okla.	15,144	4723	93.0	6500	288			266	1617	267
Delaware Power & Light Co., Wilmington	802				7				10	
Empire Southern Gas Co., Fort Worth, Texas	487	110	16.0			5				90
Eastern Kansas Gas Co., Iola, Kan.	10									
East Ohio Gas Co., Cleveland	10,000		113.0		10,000					
Frederick (Md.) Gas Co. Inc.	100							10		
Fitchburg (Mass.) Gas & Electric Co.	59								3	
Gas Light Co. of Columbus, Ga.	550									
Gas Service Co., Kansas City, Mo.	5531									
Gas Service Inc., Nashua, N. H.	50								5	
Great Falls (Mont.) Gas Co.	143									
Godfrey L. Cabot Inc., Charleston, W. Va.	1000								285	715
Hartford (Conn.) Gas Co.	620							1	16	
Hastings (Neb.) Utilities Dept.	81									
Haverhill (Mass.) Gas Light Co.	359								13	
Hoosier Gas Corp., Vincennes, Ind.	165	50	4.8			4	1	2		
Hagerstown (Ind.) Gas Co.	56									
Houston (Texas) City Gas Dept.	498									
Houston (Texas) Pipe Line Co.	1505	755		100	100					
Iowa Electric Light & Power, Cedar Rapids, Iowa	1895			135						
Iowa Power & Light Co., Des Moines	1971			228					700	
Indiana Gas & Water Co. Inc., Indianapolis	2379	836	43.0	65	67					
Iowa Public Service Co., Sioux City	1291								200	
Kansas-Colorado Utilities Inc., Lamar, Colo.	73			10						
Kings County Light Co., Brooklyn, N. Y.	255	5		20					50	
Knoxville (Tenn.) Utilities Board	304								101	
Laclede Gas Co., St. Louis, Mo.	9125								17	
Lone Star Gas Co., Dallas, Texas	22,669	1213	49.2	683	55	455		140	3778	4223
Louisiana Power & Light Co., New Orleans	1418									
Lake Shore Gas Co., Ashtabula, Ohio	432									
Long Island Lighting Co., Mineola, N. Y.	5797								85	
Madison (Wis.) Gas & Electric Co.	372								21	
Manchester (N. H.) Gas Co.	194								5	
Metropolitan Utilities District, Omaha, Neb.	1914									
Memphis (Tenn.) Light, Gas & Water	1915									
Michigan Gas Storage, Jackson, Mich.	2733	1747	36.0		865	30		23		
MidSouth Gas Co., Little Rock, Ark.	371									
Minneapolis (Minn.) Gas Co.	8145								27	
Mississippi Valley Gas Co., Jackson	1591							2	1	
Missouri Power & Light Co., Jefferson City	476									
Missouri Utilities Co., Cape Girardeau	250	35	4.0							
Missouri Natural Gas Co., Farmington	333									
Missouri Public Service Co., Warrensburg	4411	2904	116.0							

STORAGE				DISTRIBUTION								GENERAL					
Holder	Under-ground	Pipe	Misc.	New Mains	Miles of Main	Meters Repl.	Meters and New Service	Reg. Sta.	Cath. Prot.	Autos and Trucks	Const. Equip.	Other	Adm.	Office System	Bldg.	Shop and Lab.	Comm.	Other
				2007	220.0	30	1583	70	5	190	54	61		58		100	6	26
				65	20.0	10	54	6	15	10				5	15	3		
				214	30.0	154	3	1								10	4	9
				106	17.5		130	4								5		7
														1			34	
				506	25.0	262	598			145		41		42	48	2		
				56	1.7	38	137			11		10	7					
				1095	13.0	235	1680	325		165						150	40	
				150	8.0	20	79			13				2		2		
				20	4.0		5	5		2								
				239	18.0	107	228	110		25	4			4		33		
								224							2			
				165		67	76			15	7			5				1
40						2	1			10				9			1	
				223		49	143	10	14		1			5		13	1	18
				293	20.9	255	702	48	15						430	18		
				634	66.0	177	537	9	5	87	46			37		22	12	17
				91	12.0	12	47		1	10							1	
				417	18.0	4	216	10		6	22							
	570			1271	115.0	270	549	54		96	50	52		81	725			75
				30	2.0	30	30	10	3	7	2			3	1		6	
				42			20			4	4							
				180	25.0		125	15		5								
				224		43	143	15	8		15	30						
				97	5.1	15	63	27		10		8		1		8		14
	902			900	38.0	1470	717			296				32		19	84	93
2	98			1050		200	600	73							122			
9	532			4989	193.0	2220	6554	580	3	592	183			143	27	837	166	
				195	19.4	2	43			8	1			2			1	
				142	13.0	24	32	3						6				5
14				221		277	170	45										
300								7050							1500			
							400							100			700	200
			60	75	10.0	150	125	50	50	30	15			75	30	10		
				219	8.0	194	85	3		12								
				316	20.0		200											
				1142	60.0	600	500	140	28	60	161		2		15			2
	5			165	18.0	79	112	1		29		22		9			30	
				75	2.0	163	397	30			20							
143				28	1.0	6	49	12	6	12				10		2	1	
				53	1.5	10	10	1		6								
	1065						125							29			54	210
				169		229	347	6		18	16							
				210	60.0	7	30			9	10							
				9			1											
			10					80										
				20	1.0	5	30							1				
				440		25	70						15					
				2700		250	1708	360		183	95			85		150		
				35	3.0		10											
				81		24	19			2	17							
				267	11.0	22	176			54	30			22		32		
						70				2	5						4	
				150	6.0	15	62	35		20				10				54
	51			27	1.3		13	2		8	3			3		1		
				35	2.0		18	1		1	1							
						480	11			6							1	
				250			150			75					75			
				460			311					990						
				506		91	394	31	1	20								
	75			213	30.0	80	909	54		30	20			10				20
				582			420		58	10	20					1		
				30	12.0	25			2	3	3							
							130	25						10	15			
				65			58								80			
	1347			2689	122.0	914	2112	121				1106		47	552			220
	977			4656		1451	2425	45	6	530				196	1742	27	45	22
				600		50	667		25	60	16							
				184		47	112	57		12		9		11				
10				2157	146.0	816	2271	200	49			31				173		5
				75	3.6	128	80	5		8	1			5	49			
25				90	4.0	10	36	5		10	8			5				
				838	88.0		735	115		91	42	78			15			
				750		70	350	63	32	70	65			50	400	35	30	
	36	32															1	
				129		18	135	24	15	26	9			6	9			
				5453	152.0		1619	110		198		162		49	26		13	488
		1		712		150	557	35	10	33	22			22	14	3		29
				225	20.0	80	150	10		8	3							
				87	12.0	61	60	3		3						1		
				146	12.0	55	90		20	12	4			5		1		
				719		69	664	22		15	1	17						

1955 building budgets of 177 gas companies

1955 building budgets of 177 gas companies

COMPANY	TOTAL	TRANSMISSION						PRODUCTION	
		New Lines	Miles of Line	Repl.	Comp. Sta.	Autos and Trucks	Const. Equip.	Misc.	Plant	Drilling
Mobile (Ala.) Gas Service Corp.	967									
Milwaukee (Wis.) Gas Light Co.	5895								55	
Minnesota Natural Gas Co., Worthington	75									
Michigan-Wisconsin Pipe Line Co., Detroit, Mich.	11,435		251.9		11,435					
Minnesota Valley Natural Gas, St. Peter, Minn.	500									
Natural Gas Pipeline Co., Chicago, Ill.	28,437		350.0		28,437					
Natural Gas Storage Co. of Illinois, Chicago, Ill.	5140	4890	31.0					250		
Niagara Mohawk Power Corp., Syracuse, N. Y.	11,060	795	21.0	280	130				283	
Nashville (Tenn.) Gas Co.	919									
Nevada Natural Gas Pipeline Co., Las Vegas	600	600	44.0							
Nevada Southern Gas Co., Las Vegas	400									
New Orleans (La.) Public Service Inc.	1486									
New Haven (Conn.) Gas Co.	500								1	
New Bedford (Mass.) Gas & Edison Light	473								100	
New Britain (Conn.) Gas Light Co.	219								58	
New York State Electric & Gas Co., Ithaca, N. Y.	4836			669					102	
Northwestern Public Service, Huron, S. D.	561								84	
Norwich (Conn.) Dept. of Public Utilities	85									
New Jersey Natural Gas Co., Asbury Park	1568								40	
New York State Natural Gas Corp., Pittsburgh, Pa.	9614			2751					2405	
Northern Indiana Public Service Co., Hammond	5213								213	
North Shore Gas Co., Waukegan, Ill.	1577								1	
Northern Illinois Gas Co., Aurora, Ill.	17,090								1000	
Ohio Gas Co., Bryan, Ohio	255									
Oklahoma Natural Gas Co., Tulsa	10,294	957	126.3	888	53				2522	1944
Pacific Northwest Pipeline Corp., Houston, Texas	160,000		1899.0		160,000					
Panhandle Eastern Pipeline, Kansas City, Mo.	16,154	3605	106.3		105			36	4460	3636
Peoples Gas Light & Coke Co., Chicago, Ill.	15,480								1541	
Peoples Natural Gas Co., Pittsburgh, Pa.	4859	370	41.0	205	101			85	377	430
Petersburg (Va.) & Hopewell Gas Co.	353									
				904		372	59	85	48	
Philadelphia (Pa.) Electric Co.	7588	1808	13.6	50					368	
Public Service Electric & Gas Co., Newark, N. J.	31,500								9320	
Piedmont Natural Gas Co. Inc., Charlotte, N. C.	1500									
Pioneer Natural Gas Co., Amarillo, Texas	10,029	5880	538.0	306	570	57	32	18		
Providence (R. I.) Gas Co.	550								50	
Pineville Gas Co. Inc., Monroe, La.	90									
Portland (Ore.) Gas & Coke Co.	874								145	
Public Service of Colorado & Subsidiaries, Denver	5466				55			43		
Portsmouth (Va.) Gas Co.	142								14	
Philadelphia (Pa.) Gas Works	9204	352	3.0		915				460	
Pacific Gas & Electric Co., San Francisco, Calif.	24,094	4382	150.0	197	199			345	32	
Richmond (Ind.) Gas Corp.	125									
Rochester (N. Y.) Gas & Electric Corp.	5556								310	
Rockland Light & Power, Spring Valley, N. Y.	950								75	
Roanoke (Va.) Gas Co.	394									
South Georgia Natural Gas, Birmingham, Ala.	8600		402.0		8600					
San Antonio (Texas) Public Service Board	2459									
Southeastern Michigan Gas Co., Port Huron	350									
Southern California Gas Co., Los Angeles	27,925			4400						
Southern Counties Gas Co., Los Angeles	16,054	2500	31.5	287	108	3	1	281		
Southern Indiana Gas & Electric Co., Evansville	853								3	
Southern Union Gas Co., Dallas, Texas	6581			280					807	2030
South Jersey Gas Co., Atlantic City, N. J.	2050	547	19.1			2		2	9	
Superior (Wis.) Water, Light & Power	29									
Sierra Pacific Power Co., Reno, Nev.	750								336	
South Carolina Electric & Gas, Charleston	877									
Seattle (Wash.) Gas Co.	1123								48	
San Diego (Calif.) Gas & Electric	4463				550			18	3	
Springfield (Mass.) Gas Light Co.	1256								140	
Tampa (Fla.) Gas Co.	58								1	
Tennessee Gas Transmission Co., Houston, Texas	81,347		801.0		63.700					
Texas Eastern Transmission Co., Shreveport	82,959	48,206	400.0		27,348			6712		
Texas Gas Transmission Co., Owensboro, Ky.	19,150	11,675	206.0		5825					
Tucson (Ariz.) Gas Electric Light & Power	610									
Transcontinental Gas Pipe Line Co., Houston, Texas	83,000		580.0		83,000					
Texas Eastern Penn-Jersey Transmission Co., Shreveport	3714				2821			893		
Trunkline Gas Co., Houston, Texas	18,700			18,700						
Texas Gas Corp. & Texas Gas Pipe Line, Winnie, Texas	3500		40.0		3500					
United Gas Improvement Co., Philadelphia	4921								398	
United Natural Gas Co., Oil City, Pa.	2963	170	9.0	763				75	50	180
Union Light, Heat & Power, Covington, Ky.	1115									
United Fuel Gas Co., Charleston, W. Va.	13,992	1698	44.0	466	220				1473	1973
Virginia Electric & Power Co., Richmond	2601								82	
Water, Gas & Sewage Dept., Duluth, Minn.	76									
Washington (D. C.) Gas Light Co.	14,000								5	
Westcoast Transmission Co. Ltd., Calgary, Canada	36,000	36,000	650.0							
Wisconsin Southern Gas Co., Lake Geneva, Wis.	298									
Willmut Gas & Oil Co., Hattiesburg, Miss.	200									
Wisconsin Fuel & Light Co., Monitowoc, Wis.	200								20	
Wisconsin Power & Light Co., Madison, Wis.	495									
Westfield (Mass.) Gas & Electric Light Co.	92									
Worcester (Mass.) Gas Light	1059								126	
Wisconsin Natural Gas Co., Milwaukee	1470									
Wilcox Trend Gathering System Inc., Shreveport	3144	885	16.0		1917			342		
West Tennessee Gas Co., Jackson, Tenn.	105								1	
Western Kentucky Gas Co., Owensboro, Ky.	1900									
Wisconsin Public Service Corp., Milwaukee	847								4	

STORAGE			DISTRIBUTION								GENERAL					
Holder	Under-ground	Pipe	Misc.	New Mains	Miles of Main	Meters and New Repl.	Service	Reg. Sta.	Cath. Prot.	Autos and Trucks	Const. Equip.	Other	Adm.	Office System	Bldg.	Shop and Lab.	Comm.	Other
				424		51	426			20				24	22			
				1300	56.0	982	3054	42		175	124			35	94	28	6	
				8		6	51	5		5								
				←	305	→	35		50			110						
				5279	300.0	1713	1651	724	30	150						15	10	
				470	35.0	10	380	10	1	21	17				10			
				190		50	150	2		3	5							
				416	23.7	451	431	25		35	23			15	80	10		
				231	8.0	10	202			28	20			7		1		
				156	5.0	20	60	40		19	13			2				5
				97	4.0		108			6	4							
4				1739	45.0	1445	719	100				60		2				
				179		110	80	20	5	30	34			4		5		10
				23	1.3	16	12			7				1	1			
25				458	48.8	177	760	41	2	73				15			2	
													←		116			→
	4342																	
				983	65.0	628	1979	134	13	236	38	500		52	415	6	11	
				810	20.0	228	400	28	10	28	31			10	25		6	
				7560		955	4161	304	50	450			1600	110	785	110		5
				77	4.0	51	55	1	2	7	6			5	43		4	4
	21	24	18	1706	252.5	943	401	212		131				226				248
	2671																	
				3560	47.5	375	4340	150		329	261		430	252	2999	973	18	252
	88			1818	48.0	160	718	199		120		44		10		59	34	
				186	22.0	33	126			2	4						2	
														32	111	8	22	
													←		720			→
				2529	140.0	755	1258	85	15									
				13,000	400.0	1000	4460	300		700	70	1300		65			20	65
500				800		65	364	25	10	20		204		4		8		
				733		189	1051	29	29	110	24	91		10	900			
				350			150											
				38	8.0	25	15		2	1			←		1			→
						489	173			25		5		5				32
				1929	242.0	546	2560	197	40	28					68			
				41			55			10	11			8	1	2		
				2120	39.8	2020	2224	226		135	120			50	175	219	2	36
150				9723	500.0	1889	6837	219	52		49			85		85		
				100			25											
				3411	75.0	246	1350	189	25		25							
				500		40	250	20	1	30	30						4	
				342	22.0		33	6		7	4							2
				1026		40	735	88	150	9	66			1	340	4		
				100		50	150	5	5	10				10			5	15
←		3750	→	←				19,755				→	←		5089			→
				3300		1800	6291	86	30	487	7	172		60	641			
	252			219	11.7	77	224	28		17	18			2	11	2		
				←				3252				→	←		212			→
				624		246	423		6	28	33		16	26	72		5	11
1				1		7	18	1								1		
				249	7.0	19	125	6		13						2		
				568			275	20		12						2		
				865	13.0	18	64	16		30		73		6	3			
	619		3	900	70.0	601	1110	25		90	14			17	266	15	15	217
				677		121	175			21				27	75	5		15
10							38			4				5				
←		14,647	→										←		3000			→
	693																	
	1000																650	
				400	60.0	100	90	5		5						5	5	
100				1692		747	←	1145	→	128	52			40	←	157	→	462
	416			615	20.0	415	134	36		65	20							15
				823	15.0	45	85	105	3	9	45							
	4703	947		499	53.0	803	327	30				92		59		275	73	245
200				1957	100.0		288			58						16		
				59	2.5		8			4	4			1				
5	2240			6695	195.0	215	3360	385	355	285	150			50	230		25	
				142		57	78			16				5				
				←		200		→		3	15					5		
				140	9.0	7	20	5		3	2			3				
				60	3.0	300	120			5	10							
				60			5	25						2				
				427		99	218	38		42	15			4	64	20	6	
3				630		←	606	→		4				2		32	13	
				25			43	3	1	9	6			12			2	3
	191			731	6.0	98	367	33	9	61	40	53		17	300			
				113	5.6	258	375	10	3	36		38		1		8	1	

1955 building budgets of 177 gas companies

The second GAS computer symposium

By J. FRED EBDON • Panel Moderator

DISTRIBUTION engineering is at a turning point—this state of development in the art is the result of the tremendous growth of the gas industry under the impetus of increasing volumes of natural gas becoming available to the entire country, and the availability of methods and equipment that make such engineering practical under previously prohibitive conditions. Too much gas distribution engineering has been, and is being, done by time-honored "rule-of-thumb" methods. Now, many distribution properties are increasing their loads at an accelerated pace, which limits the practicality of improving distribution systems or networks on the basis of experience gained by key engineers through long years of service.

One of the tools

Electronic computers, both the analogue and digital types, are but one of the tools that progressive engineering departments in distribution companies are turning to for a more classical or scientific approach to the solution of their problems. New methods for network analysis, new instrumentation, and new physical distribution equipment are also lending their effects toward bringing the science of delivering gas to a community to its present crossroads. As is the case with any new tool, electronic computors must be proven and accepted. It is fair to say that these engineering aids are at this time going through their acceptance stage, but an important fact that should not be overlooked by any gas distribution company is that *as you learn to use computers, the more you use them, the more new additional applications you will develop for them.*

Here is why it can be said, in all fairness, that distribution engineering is at a turning point. Take the problem of distribution network analysis—a prime application for electronic computers: some companies use their long-experienced engineers to apply the rule-of-thumb method, others use the Hardy Cross or other method for analysis with pencil and desk-type calculators, others have well-developed programs for doing this work with electronic computors. Those who use the latter method report extreme accuracy and consider the devices as economical. Those who do not use them, in many cases, consider the electronic machines too expensive or complicated. Many engineering departments who do network analysis, if it is done at all, by the rule-of-thumb or past-experience method, have not even heard of the Hardy Cross method or the other accepted calculating processes considered requisite for accurate distribution analysis. In short, there is an appalling lack of network analysis in itself, while at the same time, better methods and machines are being developed and proven through years of daily use.

Part of the business

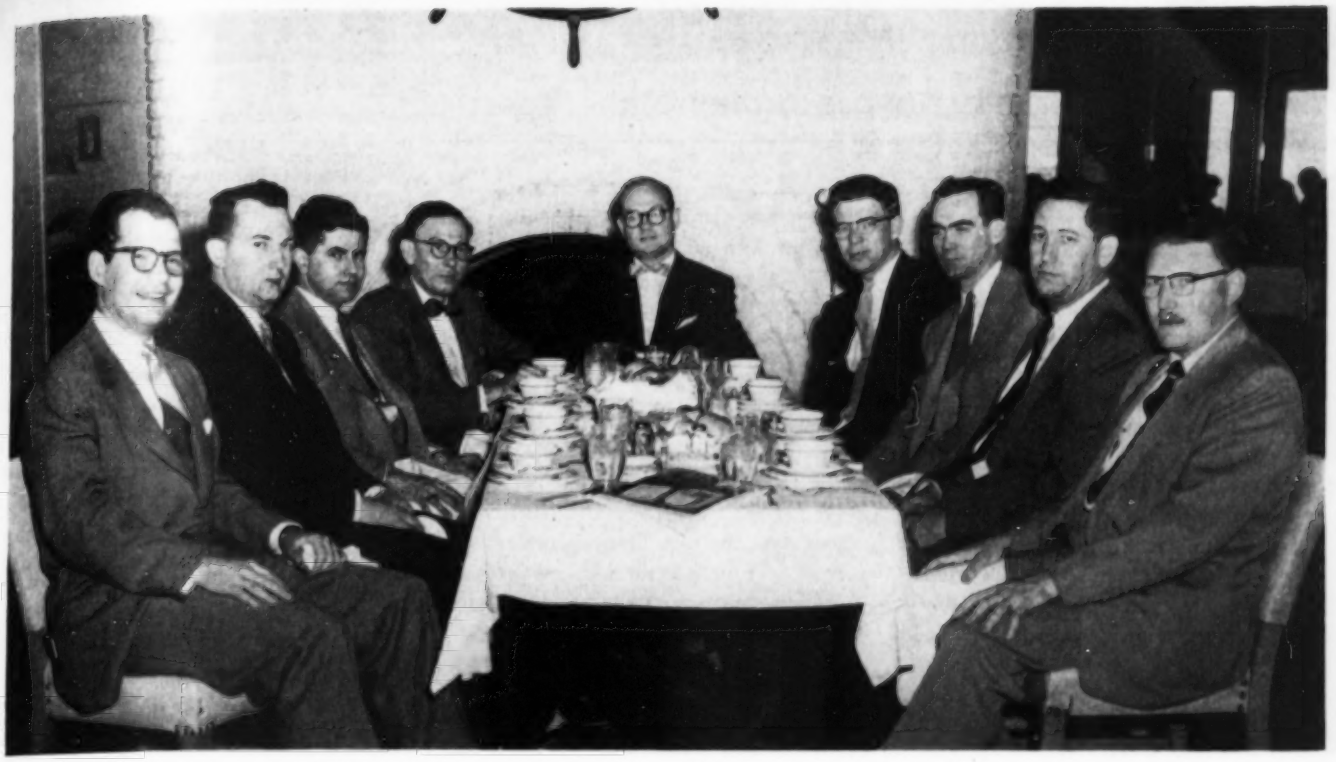
Basic network analyzers as applied to the electric industry were invented about 1924; at the present time, they are owned or used by nearly every electric power distribution company in the United States. These companies consider network analysis as much a part of their business as billing, payroll, purchasing, etc. It is not unreasonable to predict that the gas industry will reach this stage of network analysis in the not-too-distant future because (1) the problems are similar, (2) the advantages to be gained are essentially the same, (3) the pioneering work has been done, and (4) the equipment is available at lease or purchase costs that allow the results produced to pay for the original investment during even relatively short periods of proper use.

Solve a problem

One of the best methods we can think of for a distribution company to convince itself that electronic computers are a practical tool for its engineers, is to take in hand a particularly vexing network, or problem pertaining thereto, and use the excellent computer facilities of the Institute of Gas Technology to solve it. This can be done at relatively nominal expense and the results can prove very rewarding from a long-range point of view. Duane Kniebes says that IGT can work with just the problem and data; however, he strongly recommends that a man bring the problem to IGT and spend four or five days there with the problem, the computer, and the experts on the staff. This can usually be tied-in with visits to the Chicago area for conventions, etc. This is just one of the services offered by the Institute of Gas Technology, and it can be invaluable for helping a gas company evaluate the use of computers.

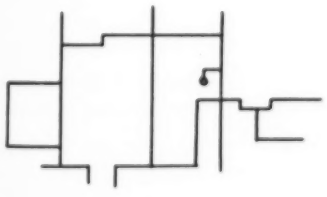
In addition, both the analogue and digital computer manufacturers will be glad to work out problem on a demonstration basis, send an engineer to talk with companies about what a computer will be able to do for them, and, probably arrange a visit with gas company engineers who are now using their equipment.

This second symposium in the computer series explores the application possibilities of these devices in gas distribution and transmission work.



The second GAS symposium on digital computers was held at the Chicago Yacht Club on March 9 with these panel members in attendance. From left: William O. Dannhausen, GAS Chicago district manager; Duane Kniebes, head, analytical division, Institute of Gas Technology, Chicago; Robert Sickafoose, engineer, Peoples Gas Light & Coke Co., Chicago; Edwin F. Trunk, assistant chief engineer, Laclede Gas Co., St. Louis; J. Fred Ebdon, moderator and managing editor, GAS magazine; Robert C. Moore, consulting engineer, Standard Electric Time Co., Springfield, Mass.; John P. Clennon, senior engineer, Peoples Gas Light; Charles L. Woody, engineer-in-charge, Texas distribution division, United Gas Corp., Houston; and Bert E. Eakin, distribution laboratory, IGT.

Potentialities of computers in solving gas engineering problems



Q For what applications are you at present actively using electronic computing equipment, both digital and analogue, in gas distribution system engineering?

Clennon and Sickafoose, Peoples Gas Light & Coke Co., Chicago, use a Starr electric analogue network analyzer for distribution network analysis. They must know the adequacy of systems to meet the demands of peak operating periods. Answers sought in the routine use of this computer are predicted compression and operating pressures throughout the systems. Other solutions sought are the prediction of what pressures will occur when particular mains are removed from service. Too, some work has been done on single-line pipelines and has been directed at the prediction of the volume of gas which could be delivered at a fixed terminal pressure.

Ed Trunk uses a McIlroy fluid network analyzer. Laclede's only use in engineering applications at the present time is for basic distribution-system analysis.

C. L. Woody, with the distribution division of the United Gas Corp., is making use of an electronic network analyzer designed and built by Mr. Woody and E. M. Harris, division engineer of the Houston division. This machine is in the general classification of a linear-function, analogue computer as used by the electrical industry. While in its present form it is not considered as the final answer, it is used to solve distribution system design problems in the form of pressure studies of existing piping networks and proposed system improvements. In addition, it is being used, on a restricted basis, for the prediction of cathodic protection current requirements.

The Institute of Gas Technology, represented on the panel by Duane Kniebes and Bert Eakin, uses a Starr analyzer for the analysis of distribution grids, feeder loops, and storage field gathering

Computer symposium... Manpower for programming has been a bottleneck

systems. In addition, IGT has used an IBM-CPC digital machine for pipeline work and, to a limited extent, for distribution network problems. It is interesting to note that IGT has an ALWAC III digital computer*. IGT feels that this digital machine will make it easier to solve many type of problems other than distribution network analysis. It is expected, therefore, that network analysis will require only a minor amount of future computer time.

When applications for computers in distribution engineering are discussed, it becomes more and more evident that there is a very close relationship between load studies, system engineering predictions and network analysis. This point was brought out at the Chicago meeting by Mr. Woody, and was echoed by these words from Mr. Clennon: "It is felt that other (than network analysis) types of applications will become more important than is the present application of this equipment. Network analysis was a problem that was difficult to solve with slide rule equipment. It was because of this that the network calculators (analogue computers) were put to use. When digital computers become fairly common, much greater use will be found for this equipment than is currently envisioned. This will come about from a small modification, or an extension, of problems that must be solved daily. With the availability of much data that are being processed, it would take very little additional work to yield information that could be quite valuable in distribution."

Mr. Trunk believes that network analysis will be the most important application of this equipment for at least the next five years. Bob Moore concurred, stating that "as long as a system is growing and its load pattern is changing, network analysis will always be of prime importance."

Q Are digital and analogue computers now in use in gas distribution systems being operated extensively?

The over-all answer to this question is "yes." For instance, as Ed Trunk stated, "our big problem is that we can't get enough manpower to keep the machine going full time. By full time, I mean eight hours per day, with no down time on the machine, of course. Our experience has taught us that if I have five men working on problem setups, we would probably have problems under continous analysis on the board (McLlroy analogue computer), but it has only been for relatively short periods, during the year-and-a-half we have had the machine, that this complement has been available, so we usually have two or three men at a time and this results in some down time.

"Further, when you consider the special problems presented by management that require computer time and/or produce drains on the computer manpower, the machine may have a week or ten days of down time," Mr. Trunk said. "At the present time we have six or eight problems ready to go on the analyzer. The system that works best for us is to have four men continually preparing problems. Each of these men then teams up with the fifth man to make a two-man team for operating the board."

Mr. Clennon and Mr. Sickafoose agreed with Mr. Trunk. Their experience at Peoples Gas Light & Coke Co. has shown that the necessity of supplying information and data to the equipment brings about a timing delay, with consequent downtime.

The analogue calculator at IGT does not have a backlog of problems, but Eakin and Kniebes believes that when the digital equipment is installed, it will enjoy 100% load factor use. This is due, in part, to the planned variety of applications.

Mr. Woody stated that the analogue computer at United is used for the solution of from 25 to 50 distribution system studies each year, and that they now have a backlog of work for it. "If we ever quit adding loads, there will be no backlog; however every time a new major load is added, in terms of a distribution system being considered, it results in a new problem. What it amounts to is pulling out of the library or files a previous study on the system being worked with, and putting it on the board after adding the new loads," he said.

In addition to the "routine" applications, there are important special applications that point up the extensive utilization of electronic devices for distribution computations. These are (1) emergency use and (2) entire system analysis and forecast use. Ed Trunk illustrated Laclede's recurring use of the McIlroy analyzer for emergency investigations as follows:

"If your system has a valve within it that is in bad shape and needs to be replaced, can you shut the line down tomorrow so that this replacement can be made? How in the world can you decide this accurately without a computer?

"If you make your determining calculations by hand, tomorrow has come and gone before you finish the calculations," he said. "You can set it up quickly on the analyzer and accurately tell the operating department whether it can be done tomorrow, or at what temperature it can be done, or what will have to be done in the way of a bypass.

"We had a strictly operating problem that fit the emergency classification, and that was to supply the answer to the question of what volume could be put through a system, and what suction pressure would be experienced at an underground storage facility, with specific delivery pressures and holding desired pressures at certain points in the system. We actually ran off 29 load combinations, with combinations of conditions, in one week with one man working most of the time, although a second man worked during the two days this series of problems was on the board."

To illustrate point number two, Mr. Trunk told the panel members:

"We at Laclede have a rather ambitious program in mind. We intend to make a complete analysis of the whole system for present and future loads, and we figure it will take about two

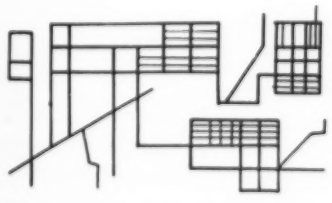
*Made by Logistics Research Inc., Redondo Beach, Calif.

years to do it with five men working on it steadily. Once we have made that, I think we can keep current with two men. It would be necessary then to merely go back and work on those places that are weak. There are lots of parts of the system that will stand the more-or-less 'ultimate' loads that will be put on them—you don't have to worry about them until you reach that point. We will just have to keep repeating on the ones with loads that are close to capacity." Mr. Woody mentioned that this is essentially the program that United is using for its Texas distribution division.

Load forecasts

Mr. Clennon joined this discussion by adding, "We have been operating [with electronic computer methods] on load forecasts which are based presently up through 1963, at which time we anticipate a billion-a-day sendout. We have been designing for loads of that magnitude, so it's necessary to have load information and manpower to analyze the loads to determine what changes are wanted before a computer can be applied to it.

"This problem of developing and maintaining a source of adequate information for high-speed calculations or analysis is something that anyone contemplating the use of electronic computing equipment should look into."



Q What is the maximum size (that is, the largest number of loops, loads, and feeds) distribution system or segment of a system that you have analyzed at one time with electronic computing equipment of either type?

The size of the systems that can be handled with one run is important. For each problem, there is a basic amount of pre-computer data-gathering, planning, and/or programming that has to be done. Often, this preparation or programming time looms relatively long when directly compared to running time. Actually, computer men in the gas industry make a distinct differentiation between preparation and programming or setting up. Preparation is usually meant to include going back to customer accounts, etc., to gather the basic data that provide the variables or parameters for the problem. The collection and preparation of data is essentially the same regardless of how the analysis is to be made. Programming digital and analogue computers is similar in several respects. Time must be spent in converting hydraulic data and terms to computer components and terms. On both types it is necessary to assign computer components (cards, storage units, load units, source units, etc.) to represent hydraulic equivalents and to connect these computer components together according to a decided plan. The actual technique and components of various type computers are, of course, different.

Largest problems

The largest problems reported by the panel members were:

Mr. Clennon, on a Starr analogue analyzer: 20 loops, having seven feed points, with 60 loads and 101 sections of pipe. This almost equalled the capacity of Peoples Gas' equipment.

Mr. Eakin, using IBM-CPC digital equipment: four loops, with one feed and 10 loads. (This problem was of little consequence as far as size is concerned—it was run to test IGT's general method of solution.)

Mr. Kniebes, on a Starr analogue analyzer: 84 loops, with 120 loads and two feeds. This board has been used for problems involving feeder loops with 32 loads and 10 supply points at three different pressure levels.

Mr. Moore, representing the Standard Electric Time Co., reported the largest McIlroy analogue analyzer built to date has a capacity of 568 lines with 20 feeds and 180 loads. This is about equivalent to 160 loops with the abovementioned feeds and loads.

Mr. Sickafoose, using IBM machines: 400 loops, with six feeds, 500 loads, 1000 sections of pipe.

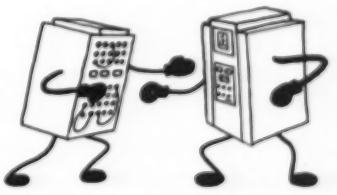
Mr. Trunk, with a Standard Electric Time-McIlroy analogue analyzer: 120 loops, with 11 feeds, 163 loads, and 305 pipe sections.

Mr. Woody, on the United Gas analogue analyzer: 192 line sections, with 180 loads.

This will give an idea of the sizes of problems that are being done today on electronic computing equipment. It is not a true comparison of the equipment itself, for if it is desired, it is valid to assume that the manufacturers can build a computer that will handle problems of much greater magnitude.

Inequitable

It is obvious that small problems might require preparation, set-up, or programming time that would be inequitable for a short computer run. The size of the problems that have been run by members of GAS' panel indicates that there should be little hesitancy to conclude that the present calculators can handle problems of a size that produce real economy when applied to modern electronic methods.



Q For gas distribution work with computer techniques, which type of computer (digital or analogue) do you prefer or find the most applicable to your problems?

The question of digital-vs.-analogue equipment keeps turning up wherever computer men gather to discuss their work. Actually, we can see little conflict or basic argument between the two types. The analogue computer, such as the McIlroy or Starr, is designed and built for one specific job; that is, the problem of analyzing complex distribution networks. It is apparent that it does this job efficiently and accurately. The digital machines, on the other hand are general-purpose calculators for which

Computer symposium... There's a place for both types of equipment in the gas industry

methods have been formulated to permit the solution of distribution network analysis. In addition, any problem that can be stated and equated mathematically can also be solved with a digital machine. From there it would seem that a company that desires to use these modern high-speed tools would make the type decision based on what it wants to do with the quipment.

If any argument does exist, then, it is that of a specialized tool vs. a general purpose tool. As in the case of any other tool that might be used in distribution work, each has its advantages and disadvantages, so the company must select the type that will most effectively fulfill the objectives that have been set for it by the particular company that will use it. *There seems to be ample reason for the segment of the gas industry that is composed of the larger companies to consider the use of both types of computers.* Mr. Moore, consulting engineer for a builder of analogue computers, emphasized this point by declaring that "the electric utilities have used both digital and analogue computers for many years. The prodigious growth of the gas industry must surely have increased its accounting and engineering problems to the same degree."

Speed

The Institute of Gas Technology has found that, on the basis of a relatively small problem, the digital computer is much faster than its linear-type analogue machine in obtaining a solution. IGT believes that the same situation will exist in the case of the larger problems. Mr. Kniebes, with Mr. Eakin in agreement, said:

"Present indications are that larger gas companies can or soon will be able to justify a moderate size digital computer which will satisfy all of their high-speed computer needs. Future developments in analogue computers may justify their use in addition to digital types, however. Smaller companies, of course, may be limited to analogue computers because of cost considerations."

Mr. Trunk presented an interesting opinion. "The speed and versatility of the McIlroy analyzer is such that at present I, for one, can see no place for the digital computer. We are unable to get enough manpower to keep our analogue machine busy constantly," he said. "I can see how a company that has digital equipment for other purposes (accounting, billing, etc.) might well take advantage of idle time on digital equipment to run off an occasional problem when the analogue is busy on a long set up.

"I can't imagine any company buying both for distribution work. In my opinion, a company would be better off with two analogues if there is more than enough work for one (although where they can get enough engineers to keep two McIlroys busy is beyond me).

Efficiency increases

"However, the use of any tool will usually result in more efficient and wider use of it as techniques and applications are learned. Economics is a major factor in determining the choice in the case of digital and analogue computers."

Mr. Trunk feels that the Standard Electric-McIlroy analogue analyzer, used at Laclede, has almost paid for itself during the time (one-and-one-half years) the company has had it. Therefore, even some down time in the future will not constitute much of a worry. With a given digital machine, however, Mr. Trunk thinks there would be a much better chance of doing much larger problems during one run.

Said Mr. Sickafoose:

Duane Kniebes, IGT: "Present indications are that larger gas companies soon will be able to justify a moderate size digital computer that will satisfy all of their high-speed computer needs."

"With a punched card system and a digital computer, you can build almost any size of system that you want. All data and results are stored in the cards, and numerous iterations are performed until you reach an answer that shows the network is in balance. The same program is used to calculate each loop; therefore, the programming device is set up to calculate for one loop—when the computer finishes one loop, it goes on to the next loop—everything is repetitive. With this program, any number of problems can be worked.

"We studied a system of 1000 mains, made up of 400 loops, with about 500 load points at the junction of the mains. The area covered was about 5½ square miles on the north side of Chicago. Six sources of supply were used, and the results of the calculations indicated that we had the alternative of adding more low-pressure feeder mains in the area from the district regulator stations or adding new sources of supply. We want to rerun the problem with the two new sources of supply added. Actually, all of the information and data are stored in 2262 cards used in the final iteration; now, I can put the two new sources of supply in the cards and rerun the problem. There will be about 100 new cards when we do rerun the problem; these will be necessary to show both the new supplies and some other changes that I want to make."

No mathematical work

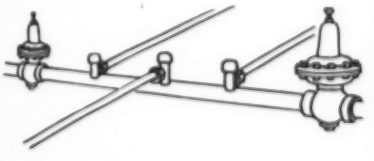
It should be pointed out that these calculations do not involve any mathematical work that could not be done with pencil and desk-type calculators. However, in Mr. Sickafoose' problem, there were six sources of supply. With the Hardy Cross method, properly applied "by hand," the periphery of the area supplied by each regulator station can be determined. The network can be brought into balance, with all regulators operating at the same pressure, by proper looping of the regulators with the large diameter mains in the network. Thereby the area served by each regulator is determined, and only pressures on the periphery of the entire network under consideration are questionable. Then, if results of the separate problems are compared and found to be out of balance, it is obvious that the peripheries as estimated are incorrect. The logical next step then would

be to assume some corrections and see if the system could then be brought into balance. One can see that this could be a long, drawn-out calculation. Thus, it is evident that modern computers, given large blocks of distribution systems for analysis, reap many economical advantages.

Mr. Clennon pointed out that "in evaluating the two types of equipment, the time necessary for, and the frequency of, solutions should be noted. It might be pointed out that with a digital computer it is necessary to process all data for one variation in the conditions; with an analogue computer, on the other hand, very often it is not necessary to resolve the entire problem, but rather, conditions can be varied and results examined."

Summation

Bob Sickafoose aptly summed up the whole digital-vs.-analogue discussion. In his words, "the digital computer, as far as distribution work is concerned, is just getting started. The analogue machines are pretty well accepted among the companies that are now using them. We must try to evaluate the two types —I don't think any of use really know which is the best or best suited. Maybe through this discussion program we can learn enough about both types so that an evaluation can be made in each case."



Q Have you used your equipment for the solution of non-looped systems?

Mr. Woody: "In general, no, although it is practical to put this type of system on computer equipment. This would be very true in the case of the continuous solution for gas dispatching."

Mr. Trunk: "We have used our McIlroy analyzer to good advantage on non-looped systems. This is particularly advantageous when such a system has two or more sources with limitations as to quantity or pressures available, or, as in our case, both."

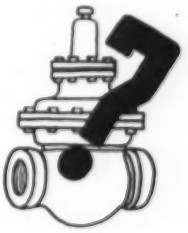
Clennon and Sickafoose: "There has been a limited application of the Starr analogue computer for the solution of non-looped systems. It has been found, however, that time necessary to arrive at a solution is not appreciably shorter than the time necessary to solve the same problem using conventional slide rules or desk calculators. It should be remembered, however, that the system we refer to did not have compressors installed on the lines, but had a fixed inlet pressure and a fixed outlet pressure with a number of takeoffs in between. The problem was to determine the maximum volume of gas that could be delivered at one point in the system under particular load conditions for all other take-offs."

Mr. Kniebes and Mr. Eakin indicated that they recently solved a non-looped problem with a desk calculator because they felt that it would have been too time-consuming to apply this particular work to their Starr analyzer to effect an over-all savings in time. However, they added that a digital computer undoubtedly would have provided a quicker solution.

Non-looped systems

Mr. Moore said that McIlroy analyzers have been used to study radial or non-looped systems. "The ease of changing load and source conditions, and the ability to read any pressure or flow without solving flows and pressures in all pipes, has appealed to many gas engineers," he said. "McIlroy analyzers may be equipped with units to represent compressors, thus making them useful in studies of transmission systems."

Q Would the value of network analyzers be enhanced by the inclusion of some device that would produce an analogy of a pressure regulator?



Some of the gas engineers who use network analyzers expressed interest in the possibility of duplicating, on an analogue board, a pressure regulator. For maximum value, this device should be analogous to a pressure regulator in operating characteristics and a simple means of duplicating a steady flow condition. The GAS computer symposium panel revealed that considerable progress had been made toward the use of this analogy.

The IGT engineers said, "To compete with digital computers, an analogue computer will have to adhere very closely to the true operating characteristics of a distribution system. Dynamic analogue devices that would reproduce pressure regulator characteristics would be a step in this direction."

"We are using an analogy of pressure regulators," said Mr. Woody. "Our approach to it is that you want to control one of two things—pressure or gas input. It's just a matter of controlling the pressure difference between the input points or the quantity of gas input at those points." This is, of course, effective on a steady-state board. On a dynamic-type analyzer, it would be desirable to obtain data from varying inputs or outputs as a function of time. Line pack study would be a significant application for this function. Although, in distribution work, line pack is not usually as important in many sections of the country, it does have some bearing on other systems.

Mr. Clennon asked, "Woody, you don't use the dynamic type of device for a pressure regulator on your analyzer, do you?"

Mr. Woody answered, "No, what we do is this: If we have more than one input point, we make one of two determinations—one of the quantity we want to put in, or of the pressure dif-

Bert Eakin, IGT: "To compete with digital computers, an analogue computer would have to adhere very closely to the true operating characteristics of a distribution system."

Computer symposium... Convergence failure of Hardy Cross method found not serious

ferential we want to maintain. Normally, we maintain the same pressures at all the input points, but on a low-pressure system, inside of an intermediate-pressure system, for instance, we do determine the inputs that we want to maintain at the various points."

Mr. Eakin said, "Yes, but what you do is connect them to a common source."

"No," Mr. Woody replied, "we connect them to resistance units so that we can maintain the desired inputs. This applies to the inputs that come in at a single pressure. These are tied in on the board at a single point. However, you can have a second distribution system, that is to be operated at a lower pressure, as a load on the first. We have many systems that operate at two or three pressures, and, of course, we are feeding down at the district regulators. For instance, we may have an intermediate-pressure system feeding into a low-pressure system and the first thing we would do would be to run out the low-pressure system on the board, either on a desired pressure or desired load condition. That, in turn, becomes load on the intermediate-pressure system. Whether we do this as one or two problems depends on the limitations of the board. There is no reason why we couldn't work the systems simultaneously if we wanted to put them on the board. It doesn't bother the accuracy of the computer. As far as the board is concerned, we can put the low-pressure system in using Pole's constants and use Weymouth's constants for the intermediate system. They operate entirely independent of each other, but we would repressure from an intermediate point into a low-pressure system."

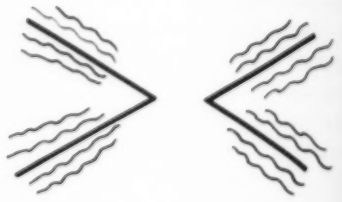
Serious consideration

Ed Trunk has been giving serious consideration to a pressure regulator analogy. "In fact," he said, "I recall Dr. McIlroy mentioning its possibilities when we first discussed the designing for our analyzer, and since then, I have asked Bob Moore (Standard Electric Time Co., manufacturers of the McIlroy Analyzer) to give me a quotation on just this kind of item."

Mr. Moore replied that, "What Standard Electric Time has in mind on this —it has already been designed, and is being built on an experimental basis —is a rheostat that will, by setting a dial at whatever outlet pressure you wish, automatically maintain itself at the set outlet pressure regardless of what the flow is through it. This is essentially a null-seeking servo system. These rheostats can be used as input regulators, at various pressures, or as regulators within a system where it is desired to analyze an intermediate and low-pressure system simultaneously." The McIlroy analyzer is used for studies for systems under steady-state conditions, and the motor-driven rheostat unit will be used principally to automatically obtain the steady-state conditions which are desired.

Mr. Clennon differed somewhat from the trend. "It is our opinion, that this type of device would not have an application to a network analyzer for the following reason. The solution to a problem is dependent upon a particular load condition, which must be assumed to be a steady state for a particular period of time, for example, one hour, or a maximum hour of one day. With this type of load, the present analogue equipment is capable of maintaining a fixed pressure at the various sources which would be analogous to the operation of district regulators. If it is found that the pressure at any particular regulator exceeds the setting pressure of the regulator, it could be concluded that this particular regulator would not supply gas to the system."

Q **In network analysis with digital equipment using the Hardy Cross method, have you found that under certain conditions the iteration fails to converge?**



In classical mathematical analysis of application of the Hardy Cross method for solution of distribution networks, some suggestions have been made that this approach (actually developed for structural analysis), although a helpful numerical procedure, fails under certain conditions. Formulation of gas network problems in mathematical terms usually produces systems of nonlinear algebraic or transcendental functions that can be handled by iterative methods yielding successive approximations to the solution. In other words, the general method produces a closed loop of steps which do the same thing over and over again, a so-called iteration loop, used to solve for some quantity by the method of successive approximations. It is relatively easy to get an iteration loop started, but it is also necessary to stop it. A programmer can do this with digital equipment by having as one step in the loop a calculation of the difference between the last two approximations. Whenever this difference is close enough to zero (being smaller than some preassigned value), he can arrange to terminate the loop. This usually is done with no trouble, but under certain conditions, it has been noted that the Hardy Cross method fails to converge and instead, oscillates indefinitely between two sets of values. Hence, GAS questioned its panel on this phenomenon.

Mr. Trunk found this oscillation produced when applying the Hardy Cross method with "hand" methods before the installation of analogue equipment. By successively halving the correction, he was able to reduce it to achieve the degree of convergence he desired.

Peoples Gas also observed this condition, but considered the degree of error produced as rather small and made it a practice to ignore it.

The panel members from IGT use the Hardy Cross method and its modification, but in their experience they have not had a convergence failure; however, they assumed convergence adequate when the sum of the absolute value of all the corrections was less than 1% of total flow entering system.

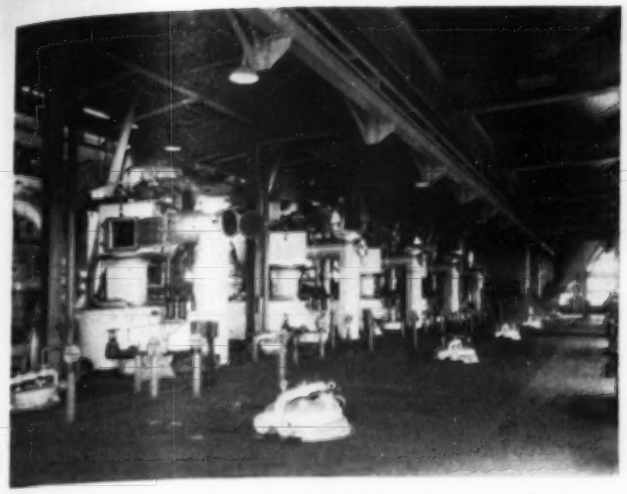


Fig. 7. Maintenance work on the water gas equipment is done on a scheduled annual basis. All equipment must be in good operating condition before the winter season.

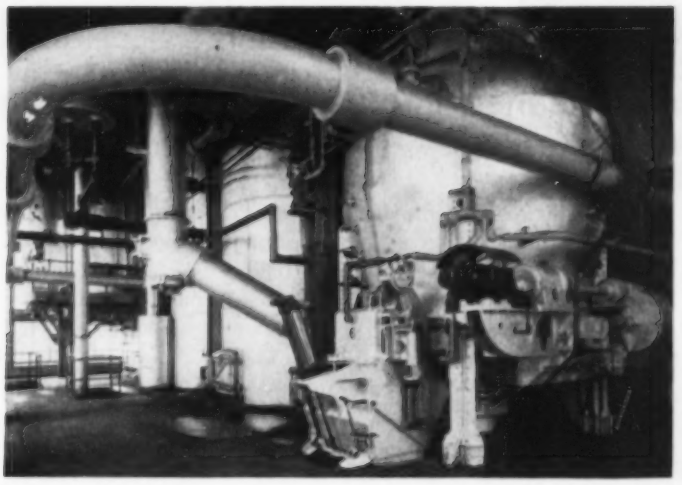


Fig. 8. Less wear and tear are experienced on the fire sides of the water jackets with the present operation of the water gas sets.

Maintenance of check points in a manufactured gas plant

By F. R. WADLEIGH, Superintendent

Hunts Point Plant, Consolidated Edison Co. of New York Inc.

In the first installment of his article, which appeared last month, Mr. Wadleigh covered the progress of coal through the coke ovens and shaker screens to the point where it is conveyed to the gas producers. In this concluding part, Mr. Wadleigh covers such maintenance points as the gas producers, centrifugal and reciprocating pumps, water gas generating equipment, and purifiers. For a flow diagram, see April GAS, page 52.

THE gas producers provide a low Btu gas from nut- and pea-size coke for heating the coke ovens and present no particular maintenance problems. The revolving cast-iron conical grates are cast in sections to facilitate replacement and are inspected on an annual basis. A grate will last several years and then need not be replaced in entirety. The sectional design makes it possible to renew the worn sections only. Each gas producer is equipped with a waste-heat boiler, the maintenance of which will be discussed under boilers. Steam turbine-driven centrifugal blowers and exhausters supply air for the process and deliver the gas produced to the coke oven heating flues.

The air blower units require little special maintenance as they operate at moderate speeds. The gas ends of the exhausters require frequent cleaning to prevent the building of deposits on the impellers. This condition, if allowed to go unchecked, will cause vibration and possible damage to the unit. The impeller is water-washed periodically and the unit receives an annual overhaul. During the latter work the unit is disassembled and the impeller cleaned by air-blasting with fly ash, which is obtained from the coke-fired boiler stacks. This material cleans without damage to the metal.

The smallest size of the coke or breeze is burned on chain grate stokers for steam generation. Stoker and boiler maintenance present no problems peculiar to a manufactured gas plant except that fly ash erosion of boiler tubes is carefully guarded against particularly on boilers heated with producer gas. Tube guards made from sections of old boiler tubes are welded in place at the point of gas entry in the waste gas units.

Corrosion of fuel chutes and stoker hoppers and the erosion of induced draft fan housings on boiler units that burn coke breeze are the most costly items on overhaul work. Kittanning brick linings have been installed on the bottoms of the fan inlets and the sides have been protected by troweling a refractory cement, which is held in place by expanded metal tack-welded to the housing. A rolled alloy steel plate on the fan blades has increased the life about three times. This arrangement has been extremely satisfactory. The use of stainless steel in parts of the stoker hoppers and lining of the chutes in the same manner as that used in the induced draft fans has doubled the life of the chutes and hoppers.

Each boiler unit is given a thorough examination, cleaning, overhaul, and

GAS exclusive

Maintenance check points...Certain boilers are cleaned internally by chemical methods

test annually. Prior to the overhaul season an itemized list of anticipated repairs is prepared. After the unit has been removed from service a careful internal inspection is made for any additional work that may be required and to determine the effectiveness of the feed water treatment. Certain boilers are cleaned internally by chemical methods, while smaller boilers can usually be put in satisfactory condition by water-washing and by the use of mechanical cleaning devices.

The larger sizes of coke are delivered to the storage bunkers above the water gas generators and thence to the larry cars and automatic charging units (see *Fig. 7*). Maintenance work on the water gas generating equipment is done on a scheduled annual basis. All equipment is required to be in good operating condition before the winter season, which means that a carefully prepared schedule must be ready by March of each year and the work completed by November. Position on the schedule is determined by the number of operating hours and the physical condition of the unit. Prior to the actual outage of the equipment, a list of the anticipated repairs is made and job orders prepared. After the unit has been taken out of service for overhaul, a careful internal examination is made which supplements the original repair list. This list is used in conjunction with the previous year's maintenance report to determine the work to be done.

The present reformed natural gas operation of the water gas sets has had a marked effect on maintenance requirements when compared with the carbureted water gas method. Temperatures are now lower and less coke is used, which means less wear and tear on the generator grates and on the fire sides of the water jackets. (See *Fig. 8*). The rotating grates, 9 and 10 ft in diameter, are heavy castings, sectionalized and designed to carry renewable deck plates, which can be replaced where required. The materials used are cast steel and nickel semi-steel. Ash abrasion required that pusher angles, heavy curved castings that serve to force the ash and clinkers outward to the ash plows, and the renewable deck plates be replaced in part at each overhaul. The center or louver sections of the grate were usually affected by heat more than abrasion and required occasional replacement.

The fire sides of the water jackets, which generate low-pressure steam for the process, are lined at the ash level with steel wearing strips welded to the jacket shells. The strips were frequently eroded and torn loose. Although alterations to the arrangement of the strips improved conditions, nevertheless it was frequently necessary to protect the jacket by bead welding between and behind the strips. Replacement of sections of the interior jacket plates in entirety was necessary periodically as the result of cracks and abrasion.

Welding was a major factor here in getting the most for the maintenance dollar. Firebox steel plate 1¼ in. thick was purchased for this work in sections, which made it possible to do the job through the top of the generator rather than through the bottom, which would have made it necessary to remove the grate, a major job in itself. The installation of replacement sections required exact rolling of the plate. This was accomplished by furnishing a template to the steel supplier and by allowing one foot on each side of the rolled section so that the plates could be matched to a true diameter for welding.

After several years of operation it became necessary to protect the exterior of the water jackets at the bottom where they were exposed to ash erosion and corrosion. Cast iron plates were secured to the underside with stud bolts and cast-iron cap nuts. A seal was provided between the cast iron and the steel bottom with sheet asbestos, asbestos putty, and red lead.

Frequent failure of the thrust bearings on the 4½-in. grate drive shafts made it necessary to improve the arrangement. This was done with excellent results by the installation of heavy duty tapered roller type anti-friction thrust bearings (*Fig. 9*).

The replacement of 20-in. and 30-in. air-blast valves is necessary at overhaul periods and occasionally between overhauls. This work was made easier and the outage time shortened by the simple expedient of dividing the maintenance crew so that the replacement valve is now delivered while the defective valve is being disconnected. The delivery route travelled by the new valve was cut almost in half when access was provided to an already existing elevator door. A most simple solution is not always immediately obvious. A very useful piece of equipment in this type of work is a fork lift truck of suitable capacity, purchased with specific clearances in mind so that the truck can go where it is most needed.

The gas, air, and steam valves, the natural gas cocks, and the steam turbine-driven air blower are operated by

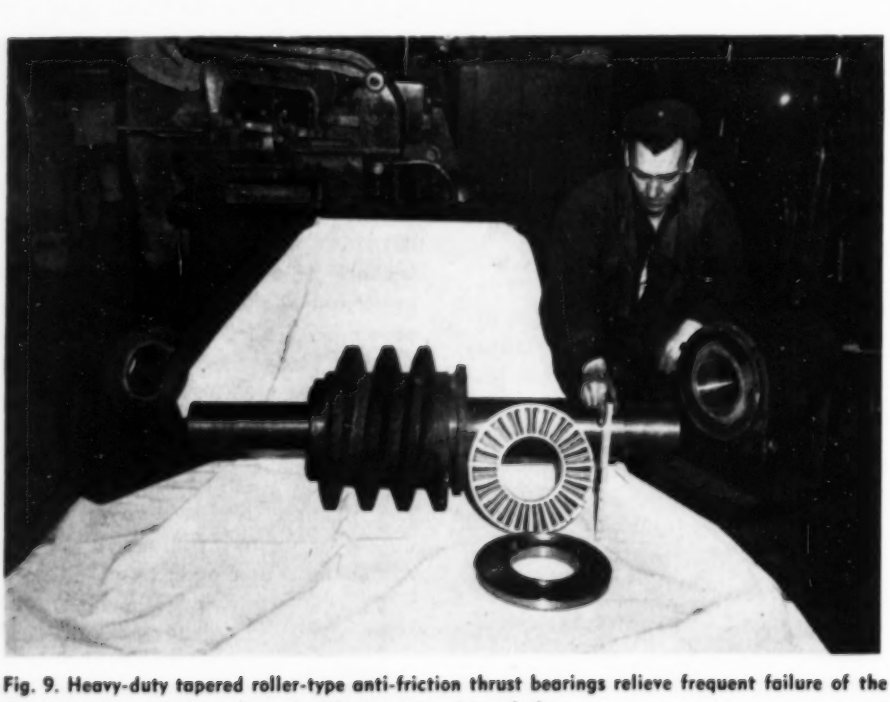


Fig. 9. Heavy-duty tapered roller-type anti-friction thrust bearings relieve frequent failure of the thrust bearing experienced on the 4½-in. grate drive shafts.

means of a hydraulic system, which is controlled by an electrically powered timing device or "automatic." Each piston operated by this system is connected to the valve stem by the piston rod and crosshead. The adjustment at the crosshead must be carefully and accurately made to assure correct closing of the valve or cock. The examination of moving parts, the replacement of cup washers, and adjustments to the new valve are usually required at each major overhaul.

Several thousand feet of control wire in conduits is required for the operation of the electrical control device for the hydraulic system. Exposure to heat makes it necessary to replace sections or all of these conductors occasionally. It is therefore important to obtain a heat resistant material that can be drawn successfully through the existing conduits. As it is often more difficult to perform a replacement job than to make the original installation, several types of wire were tried before a successful material was found. Perseverance saved the cost of installing larger-size conduits.

The reformed natural gas must be combined finally with the coke oven gas and a predetermined amount of jet gas and cold enrichment natural gas for distribution. A great deal must be done however, before this can be accomplished. The raw coke oven gas must give up its by-products, a process requiring the handling of air, tar, light oils, sulfuric acid, lime, ammonia vapors, ammonia liquor, and ammonium sulfate. The use of salt water in large quantities for cooling purposes developed the use of cast iron radiator type sections for cooling the ammoniacal liquor as an improvement upon galvanized wrought iron pipe.*

Anti-corrosive materials and an adequate painting program are good investments as atmospheric corrosion is a major cause of maintenance in this area of the plant. The recovery of tar and light oils from the water gas process does not involve the use of special materials and procedures to the same extent as that required in the coke oven plant. Each type of operation, however, is similar in the necessity for adequate maintenance of reciprocating and centrifugal pumps, steam turbines, gas exhausters, and compressors.

*The use of monel metal, lead and aluminum in by-product recovery apparatus has been so fully covered in trade literature and readily available manufacturers' publications that it would seem unduly repetitious to discuss it at length here.

Fig. 10. Operating economies on centrifugal and reciprocating pumps have resulted from the use of monel metal for salt water, which is pumped in large quantities from a river location.

Centrifugal and reciprocating pumps handle a variety of liquids, each one of which has a somewhat different effect on the materials of which the pump is constructed. It has been found that monel metal, stainless steel, bronze and cast iron are the materials normally best suited to combat these various conditions, when each material is used in its appropriate location. The economy that resulted from the use of stainless steel in the coke-quenching water pumps has been described. Results of a similar nature, but to a lessor extent, have been obtained by the use of monel metal for salt water, which is pumped in large quantities from a river location adjacent to the discharge of a large city sewer *(Fig. 10)*. Micarta valves and the use of cup washers instead of piston rings have been advantageous. An item of importance in the maintenance of pumps is a well-supervised program of shaft packing. The mechanics who perform this work should receive competent instruction and must be furnished with the correct materials for the job. There is a good profit in this work if it is done correctly.

Steam turbine-driven, direct-connected centrifugal-type gas exhausters, which operate at speeds up to 6500 rpm, are used to pump the gas from the coke ovens and water gas plant relief holder through the by-product recovery and purification system to the gas storage holder. These units are of major importance and, like the water gas sets and steam boilers, are given an annual overhaul on a prepared schedule, which requires 100% availability during the winter months.

The steam turbines do not have maintenance interest that is particularly pertinent to a gas plant. They do receive however, a careful examination at the time the associated exhauster is inspected. The work usually necessary consists of a thorough cleaning of the rotor and the oil system including the oil pumps, oil pressure governor, the low oil pressure trip (if the unit is equipped with such a device), the carbon shaft packing, and the overspeed trip mechanism. The operation of the overspeed trip mechanism on each turbine is also checked on a periodic basis. The steam nozzles are examined and repaired or renewed if required. The bearings are examined for defects, fit and alignment, and clearances and vibration readings taken on the trial run are recorded on a mimeographed outline drawing which is retained in the file jacket of the particular exhauster. It is important that this information be available in the event of faulty behavior of the unit and for guidance at the time of the next overhaul.

The inspection and repair work on these units has been facilitated by the use of a portable work bench, which is equipped with the necessary tools and is provided with a space for the temporary safe keeping of small parts that are removed from the unit. (See *Fig. 11*). The work bench can be delivered to the work location by a fork lift truck.

Centrifugal gas exhauster impellers are 28 in. and 32 in. in diameter and those of the latest design are machined from a solid forging. Each forging is required to be free of discontinuities as determined by X-ray or reflectoscope

Maintenance check points...Safety is an integral part of maintenance work

Fig. 11. A portable workbench facilitates inspection and repair work on the steam turbines.

and by magnetic particle inspection. When received from the manufacturer, each impeller is given a code number that is imprinted on the hub and recorded on an index card, which is retained in the file jacket for the particular impeller. This jacket contains the number of the order on which the impeller was purchased, the report on each subsequent test, and any other pertinent data so that a complete history is available.

At the time of overhaul the exhauster is made safe in a manner described later. The impeller is then removed from the housing to an exterior location and cleaned by air blasting with coke fly ash in the same manner as that described in connection with the producer gas exhauster. It is tested, by the dry magnafiux method, for the existence of possible defects. Although minor surface faults can be removed sometimes by careful grinding, this may require balancing. The presence of any indication of a discontinuity that might affect safe operation of the unit will result in the impeller being removed from service.

Steam turbine-driven air blowers for the water gas sets and the electric motor-driven gas boosters, which deliver the mixed gas to the distribution system, are given the same type of careful attention as that just described for exhausters.

When maintenance work becomes necessary on apparatus that contains, or may contain, combustible gas, a procedure is established for purging the equipment with an inert gas. The inlet and outlet valves are closed and locked and proper precautions are taken to see that drain valves, bypass valves or other connections are secured in a safe position. When the design of the equipment permits, a physical break is provided in each connecting line after purging. This can be done by the removal of a spool piece, tee or otherwise. If a physical break is not possible, the procedure will require special consideration. The gas valves are usually cast iron with double gates, and are sealed with water prior to the start of the purging operation. Care must be taken to see that the valve bodies are not damaged by excess water pressure or by freezing temperatures and the water seal must be sufficient to offset the maximum gas pressure against the valve gates.

The purge gas supply is connected to the lower part of the apparatus to be purged and allowed to escape at one or more vents located at appropriate locations. The vents are provided in locations such that the purge gas flows through all parts of the apparatus. Verification of purge is made by a competent chemist with the aid of a gas detector. After the purging operation has been approved, the designated sections of piping are removed and a metal blank fitted with gaskets is belted to the flange of each valve or, if the job is a special case, then the approved method is followed. The gas used for purging is either carbon dioxide or an inert gas generated by the combustion of gas in a machine designed for this purpose. Upon completion of the repair work the purging operation is again used to prevent the possible occurrence of an explosive mixture when the unit is being restored to service.

Other approved safety precautions are an integral part of all maintenance work, regardless of the presence of gas. The use of locks, uniform conspicuous signs, and a work permit procedure are standard practices and are pursued diligently. A few examples of these other precautionary measures not already referred to which ordinarily receive little publicity may be of interest:

The permanent ground connections on all light oil recovery equipment are inspected and tested for resistance semi-annually. Portable electric tools are examined and tested for suitable grounding each month. The automatic electric power changeover switches on the water gas equipment are checked monthly. Flash screens on oil tank vents are inspected monthly and replaced if necessary. The foam fire protection equipment on all oil storage and surge tanks is examined monthly, the lines are blown out and pressure-tested annually, and the foam generators are opened and cleaned each month.

Portable fire extinguishers are checked and refilled or recharged as required on a monthly basis. All fire hydrants are examined semi-annually and each month the end of line hydrants are operated to free the lines of sediment. The steam turbine and electric motor-driven centrifugal fire system pumps are examined internally and repairs made as required each year. Customary fire drills are held and tests of the fire alarm system are made frequently.

The story of maintenance in a manufactured gas plant could be told here only in part. The varied types of machinery and apparatus that are required in the operations and the numerous kinds of materials that are used make the process an extensive one of great interest. The last chapter has not been written as the maintenance forces will in this industry as well as in others continue to find and use improved methods to do a successful job. ∎

Part 5 in a Series

The New Gas Transmission and Distribution Piping Code

ASA—B31—SECTION 8

A background discussion by **FRED A. HOUGH**

Relating design of facilities to the requirements of the location

OUR earlier articles in this series on the 1955 edition of the American Standard Association Gas Transmission and Distribution Piping System Code (ASA B 31. 1 Section 8) dealt with the qualification of materials for use in such systems, the qualification of welding procedures and welders, and the design of piping system components, such as branch connections.

We come now to Chapter IV of the code, which deals with the design, installation and testing of piplines, distribution systems, compressor stations, and pipe-type holders, and which is the most extensive in the book. This article will be limited to a discussion of the general approach used by the committee in relating the design of gas transmission and distribution facilities to the specific locations in which they are to be installed and to a discussion of the provisions of the code regarding the design of high pressure transmission pipelines. Later articles on Chapter IV will cover the installation and testing of pipelines and pipe-type holders, the design, installation and testing of compressor stations and the design, installation and testing of distribution systems.

The two problems that warrant major consideration here are those connected with the selection of locations for natural gas transmission lines and the specification of hoop stress levels that are suitable for the locations in which the pipeline is to be placed. These two factors have a major effect on cost and they are among the many factors affecting public safety. They are, consequently, among the most important problems considered by Subcommittee 8.

The basic conclusions reached by Subcommittee 8 regarding these two problems are the same as the conclusions reached by the preceding committees that drafted the existing Gas Transmission code. The revised code, like the old code, limits the maximum operating hoop stress in a pipeline to 72% of the minimum yield strength specified in the pipe purchase contract and the new code, as well as the old code, requires that this stress level be reduced where the pipeline is located in densely populated areas. The new code differs from the old in the method prescribed to determine the locations where changes in operating hoop stress levels are necessary in the interest of public safety. In this respect, the new code reflects more closely actual current practice in the design of pipelines than does the old.

By and large, the old code permitted a maximum operating hoop stress of 72% of the specified minimum yield strength of the pipe in all locations except those inside the incorporated limits of cities and towns. Within those limits a maximum hoop stress of approximately 50% of the specified minimum yield strength of the pipe was specified. This method of designating where stress levels shall be changed has the virtue of being specific and subject to only one interpretation. However, it does not produce sensible results in many cases. In numerous metropolitan areas today there are districts outside the incorporated limits of towns and cities which are highly developed and have a population density typical of those inside the limits of many towns and cities. In other places, the boundaries of cities extend into remote mountainous areas for the purpose of protecting water rights, or for other reasons, and there is no reasonable prospect of substantial development in these remote districts. The lack of correlation between the boundaries of cities and population density has made it necessary for pipeline companies to use some criteria other than those set up by the old code for determining their design. Public officials have found fault with that code because of its method of designating where stress levels shall be changed.

The problem of relating hoop stress levels to pipeline locations and defining the limits within which any given stress level should be used proved to be so complex that a sub-group of Subcommittee 8 was appointed to study this problem in detail. This sub-group flew over the routes of a number of pipelines to study the practices followed by pipeline companies in the past. It also obtained aerial surveys of all of the major pipelines in the country. It employed a large engineering consulting firm to analyze these aerial photographs and to make a statistical study concerning population densities along the routes of these lines. The recommendations of this sub-group, with some modifications, were adopted by Subcommittee 8 and are included in the new code.

It was the recommendation of this sub-group that the population density in the general area traversed by a pipeline be used in determining the permissible stress level. The sub-group recommended that, in order to determine the population density in the general areas traversed by a pipeline, a zone ½-mile wide be laid out along the route of the proposed line with the pipeline on the center line of this zone and that the number of buildings intended for human occupancy within this zone be used as an index of population density and that this index be used in defining the areas in which each type of construction may be used. Precise instructions are given in the code for determining the population indices by means of which locations are classified for pipeline design purposes. They need not be repeated here; however, some further discussion of the thinking of

the committee regarding the classification of locations may be helpful.

In the first place, it should be pointed out that the ½-mile wide zone used for determining these population indices does not indicate that the committee feels that this is the width of a zone of danger. The ½-mile width was selected because a zone of this width can readily be located on typical airplane photographs used for locating pipelines and because a zone of this width, the committee felt, gives a representative sample of the general area traversed.

It should also be pointed out that it was not the thinking of the committee that the design or operating pressure of a pipeline should be changed as soon as additional houses are added which bring the house count above limits specified for a given design. The committee had in mind, in setting the stress level limits in various locations, that population density at the time of the locating of the pipeline would be used as a criterion for design, but that the design prescribed by the code should anticipate that an increase in population density along the route of the line would occur. Consequently, the design limits are set with some provision for normal increase in population.

However, pipeline designers are cautioned to make additional provision for large increases in population density at the time they design a pipeline to be located in areas near centers of population where new subdivisions or new developments are likely to be located in the immediate area traversed by the pipeline. If, in such situations, liberal provision is not made in the design of the line for future changes in population, conditions may develop that will necessitate a relocation of the line, or a replacement with heavier pipe, or a reduction in the operating pressure.

The committee considered and rejected another method for determining pipeline design requirements along the route of the line. This method would require that the design of the pipeline be changed when it comes within a specified distance of a house or other building intended for human occupancy. The committee rejected this method because it fails to recognize some of the facts of pipeline life.

It is possible, of course, to locate a major portion of a pipeline so that at the time of construction it is more than a specified distance from any buildings intended for human habitation or to use a lower stress-level design in those sections where the specified separation distance cannot be attained at the time of construction. It is not economically feasible, however, to prevent the building of buildings closer to the pipeline than the specified distance after the pipeline has been installed. Furthermore, it is not possible to keep people on highways, and railroads that cross the right-of-way, or farmers the specified distance from the pipeline. To do this, it would be necessary for a pipeline company to acquire in fee rights-of-way several hundred feet wide and to fence these rights-of-way in order to keep people the specified distance away from the pipeline.

The obvious conclusion is that the public cannot be kept a specified distance from a pipeline and, consequently, safety can only be achieved by building into pipelines sufficient safety so that the hazards resulting from people and property being in close proximity to the pipeline are within tolerable limits. The code is based upon the premise that, if the design of the pipeline is adequate for the degree of exposure of the public to the line and the line to the public in a given area, an acceptable degree of safety will be achieved and no separation distances need be specified. It is true, of course, that in order to minimize the cost of rights-of-way and of construction and in order to avoid future trouble resulting from the growth of population centers, a pipeline company will, when locating a line, locate it in as thinly populated an area as is economically feasible. When there is a choice, a pipeline company will also stay as far away from existing buildings as is feasible.

Four types of construction are specified in the code. These are:

Type A, with a maximum operating hoop stress of 72% of the specified minimum yield strength of the pipe,

Type B, with a maximum hoop stress of 60%,

Type C, with a maximum operating hoop stress of 50%, and

Type D, with a maximum operating hoop stress of 40%.

Generally speaking, the type of construction prescribed by the code depends upon the population density in the area in which the pipeline is to be located. There are many exceptions to this general rule, however, as for example in certain areas where pipelines cross highways for railroads or are located on bridges. Again ignoring a number of important exceptions, it can be stated that the 72% of yield stress level is permitted in wastelands, deserts, mountainous areas, grazing land, and farm land, provided the population density index does not exceed the value specified in the code.

The 60% of yield stress level is prescribed for areas where the degree of development is intermediate between the sparsely settled areas just described and city conditions. Fringe areas around cities and towns fall in this class. The 50% of yield stress level construction is prescribed for areas subdivided for residential or commercial purposes where at the time of construction of the pipeline 10% or more of the lots abutting on the street or right-of-way in which the pipe is to be located are built upon. The 40% of yield stress level design is prescribed for construction in large city streets where heavy traffic, many underground structures, and multi-story buildings predominate.

Thus, we see that the new code sets up four location classes and four types of construction whereas the old code had two location classes and two types of construction. While the new code is more complex, it conforms more closely than did the old code to actual practice in the industry, and is, I believe, based on very sound principles.

While it is generally true that the code limits the maximum operating hoop stress to a stated percentage of the specified minimum yield strength of the pipe, there are many exceptions to this general rule. For example, if furnace lap-weld or furnace butt-welded pipe, or pipe manufactured to ASTM specifications A 134 or A 139 is used, a joint de-rating factor must be applied. Furthermore, the maximum operating pressure of a pipeline is limited by the code to 60% of the mill test pressure for furnace butt welded pipe or 85% of the mill test pressure for all other pipe. Generally speaking, used pipe or pipe of unknown origin cannot be used at the maximum stress levels permitted for new pipe made in accordance with approved specifications.

The maximum stress levels to which used or unidentified pipe can be used are prescribed in the code. Fabricated assemblies, such as mainline connections for separators, mainline valve assemblies, cross connections, river crossing headers, etc., installed in Class I locations (sparsely located) are to be designed for a maximum operating hoop stress of 60% of the specified minimum yield strength of the pipe. ■

$y = ax^2 + b$

How GAS' sample problem was programmed on a digital computer

Step-by-step procedure for solving simple equation showed in detail by machine manufacturer.

BURROUGHS E101 PROGRAM SHEET

PINBOARD 1 $y = ax^2 + b$

Step	1	2	3	Explanation
0	K			Enter a in keyboard
1	W	0	0	Store a in memory location 00
2	K			Enter b in keyboard
3	W	0	1	Store b in memory location 01
4	K			Enter x in keyboard
5	W	0	2	Store x in memory location 02
6	B			Store x in multiply - divide register (called "B" register)
7	X	0	2	Multiply x by x
8	B			Store x^2 in B register
9	X	0	0	Multiply a by x^2
10	+	0	1	Add b
11	2			Print $ax^2 + b$ (using motor bar 2 on printer)
12	U	1	4	Transfer back to step 4
13				
14				
15				

Fig. 1. Program sheet used for the solution of GAS' sample problem. Note that three-digit words have been used; the first digit is the instruction part, the second and third digits are the address.

"MR. EBDON'S article* is one of the best introductory pieces on digital computers we have seen," wrote Frank W. Ladwig, manager of the computer section, special machines department, of the Burroughs Corp., soon after the January issue of *GAS* came off the press.

So impressed was Mr. Ladwig with the article (which was the prefatory piece in a series of symposia currently running in alternate months in *GAS*) that he and his aides programmed and ran the sample problem which accompanied it (see January issue, page 114) on the Burroughs E101 desk size electronic computer.

The E101 machine is programmed by use of a pinboard. This operation can be done at a location remote from the computer; then, the pinboard, with pins inserted in the proper locations to reflect the program desired, is plugged into the E101 and the machine carries out the program as directed by the pinboard. To facilitate program planning, and for storage and record purposes, pre-punched card templates can be marked to show the desired pin positions, and these cards are laid over the pinboard so that the pins can be inserted quickly and accurately in the holes required to program the computer to solve the problem at hand.

Mr. Ladwig sent along the programmer's work sheet, the paper template, and the printed answer sheet that were actually used to give the equation $y = ax^2 + b$. Consider the speed and simplicity of operating technique for computations with the Burroughs E101, as described in Mr. Ladwig's words:

"Here's how we solved the problem on the Burroughs E101. The programmer wrote down the steps necessary to insert the values of a, b, and x, and to solve for $y = ax^2 + b$ (this took about 10 minutes) (see *Fig. 1*). Then the pro-

*Digital Computers, *GAS*, January 1955, beginning on page 109.

GAS exclusive

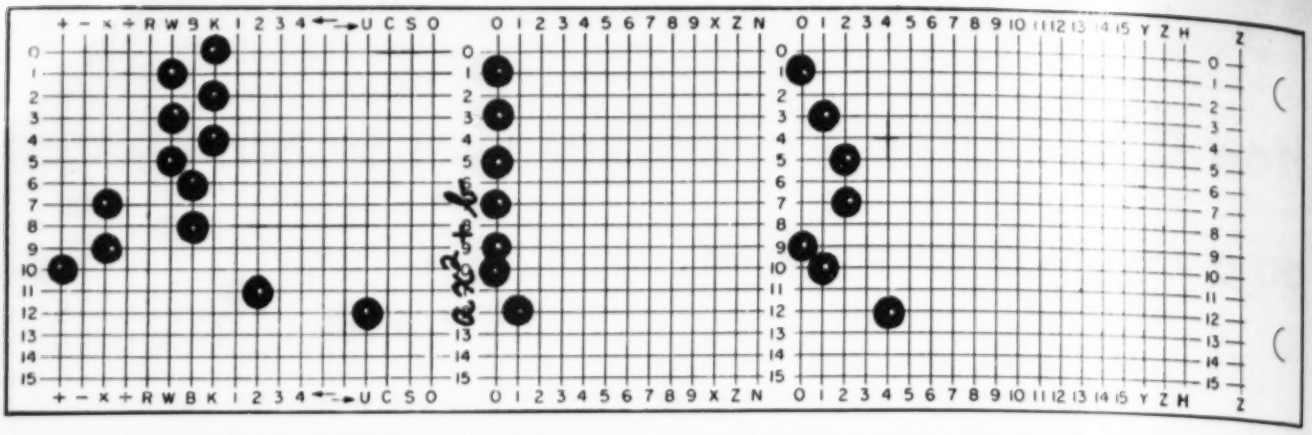


Fig. 2. This is the punched-out template used by Burroughs' programmer to set up the pinboard. The marks were placed to reflect the word used for each program step, then pins were inserted in the board using this template as a guide.

grammer stamped up the paper template *(Fig. 2)* from his program sheet (this took another minute or two). Once this has been done, either the programmer or the machine operator can lay the template over the pinboard and insert the pins through the marked holes. The pinboard is inserted into the E101 and positions of the pins instruct the machine what to do.

"As far as the operator is concerned, after he has put in the pinboard he presses the start button and first the keyboard light comes on, indicating that the E101 wants data entered on the keyboard. The operator enters the value for a, the keyboard light comes on again and he puts in the value for b. The third time the light comes on he enters his x value. The E101 computes y, prints it out next to the corresponding x (see *Fig. 3*), and returns the carriage for the next x value. The operator can keep putting in x's from graphs or tables, or he can guess at them by himself and see how close he's getting to a desired y. If x itself can be computed from a formula (for example, if we want to solve for all positive integral values of x between 0 and 100), we would, of course, program up the formula and let the E101 insert the successive x values itself. Should the operator wish to change the a or b values, he simply touches a button which takes him back to the beginning of the program calling for entry of a and b.

"Once a and b have been loaded properly, it requires just three seconds to enter and print x, calculate and print y, and return the carriage for the next x entry. Every keyboard entry normally prints, of course, so on the sample you will see first the values for a and b followed by columns of corresponding x and y values.

$y = ax^2 + b$

where $a = 1/2$

$b = 4.12$

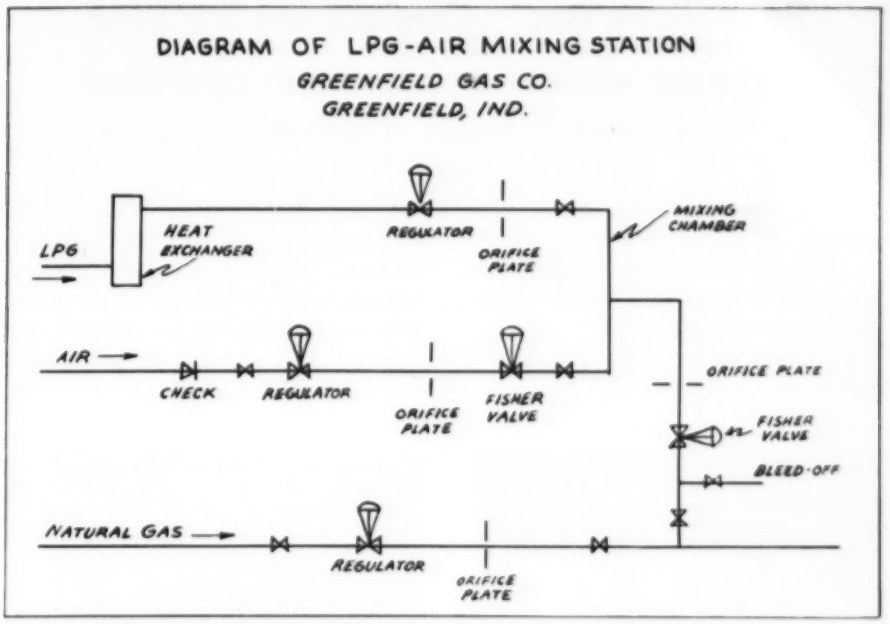
.500000 00000
4120

x	y
10000000	4620
20000000	6120
30000000	8620
40000000	12120
50000000	16620
60000000	22120
70000000	28620
80000000	36120
90000000	44620
100000000	54120

Fig. 3. The answer sheet as produced by the E101 computer. Values shown for a and b remained constant as the machine speedily produced the answer, y, for the 11 values of x used. Note how the machine's output mechanism printed the y values neatly beside each variable value for x used.

Next problem

"When the problem is finished the operator removes the pinboard and the E101 is ready for the next problem. The operator can put the assembled pinboards on the shelf if he plans to run the problem again in the near future. If not, he can dump the pins, file away the template and have the pinboard available for some other problem. The next time the problem must be run, he simply has to drop the pins through the template again and he is all set to go." ∎



Greenfield Gas Co.'s supply-demand inbalance gets leveled out quickly when this new propane-air plant goes on stream.

GAS exclusive

Peak-shave gas in 20 minutes

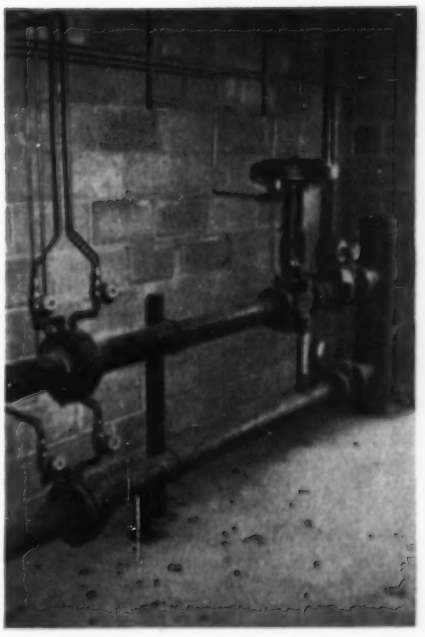
By **M. G. COOK** • The R. W. Stafford Co., Evanston, Ill.

NATURAL gas distribution system operators have long debated the advantages and disadvantages of installing some type of equipment to augment their gas supply during periods of peak demand. The need for peak shaving to eliminate some of the added operating expenses incurred when the ever increasing demand rates are in effect during peak periods, and the consideration of other gas supply factors, have influenced operating companies to give serious consideration to the installation of peak shaving and/or standby gas plants.

Economy

The decision relative to any economy produced by peak-shaving is dependent upon the individual situation and operating characteristics of a particular company, so that will not be discussed; however, after this decision has been made and if a peak-shaving plant is judged to have merit economcially, the question of the type and capacity then requires study. Large and small distribution operators are likely to be confronted with this question—in the case of the large utility, it is probable that some of its original gas-making facilities have been retained in a more or less operating condition, hence, the decision as to plant type may not be as clear-cut as is the case with the small gas distributor who very likely has retired and abandoned any gas producing equipment previously operated. In the latter case, the installation of an L. P. gas plant seems the inevitable answer.

The Greenfield (Ind.) Gas Co. is an example of the latter case. This company serves approximately 3100 meters that are highly saturated with house-heating load. Operations include natural gas delivery to a minimum of industrial consumers; some increase is being experienced in this load, but the favorable geographical location near Indianapolis and the pleasant residential surroundings afforded have drawn an influx of commuters' homes, which have produced an increase in the already unbalanced winter peaks as related to the small summer sendouts. Part of the answer to Greenfield Gas' problem was the installation of a propane plant to shave the winter peak days.



Gas-air regulation and natural gas mixing chamber. Also shown are the natural gas and LPG-air metering orifices.

The peak-shaving plant is located on fee property formerly used as the site of the manufactured gas plant and now the location of one of the two city gate sta-

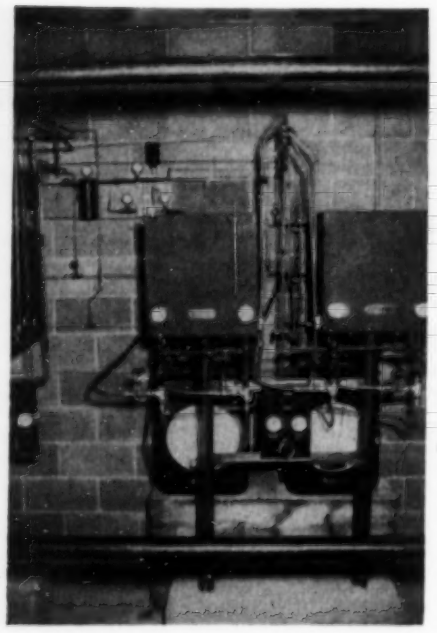
Peak-shave gas... Controls are installed to permit manual or automatic operation

tions that feed the city's distribution network. This location was chosen on the basis of availability of space although the other city gate has the larger feed volume throughput.

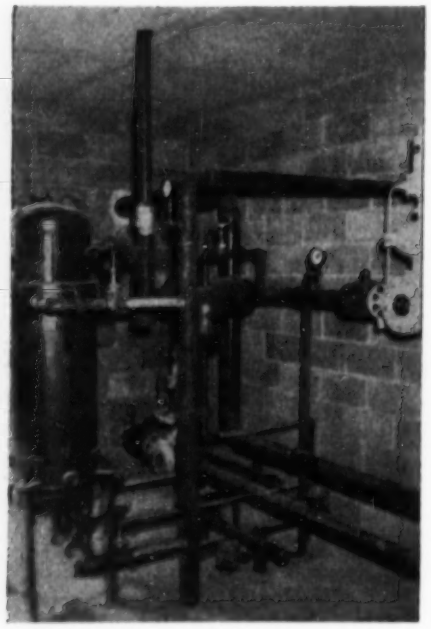
The equipment is designed to produce propane-air gas with a higher heating value range of from 1000 to 1350 Btu per cu ft; ultimately, the maximum capacity of the plant will be 100 Mcf per hr of propane-air mix delivered to the gas-air and natural gas mixing plant at 100 psig. Up to the present time, it has not been necessary to install equipment required to produce these operating values.

As operated today, the plant is producing a maximum-capacity of 50 Mcf per hr of the gas-air mix at from 20 to 50 psig. If it is desired to increase the capacity to its designed properties, only additional air compression equipment is needed.

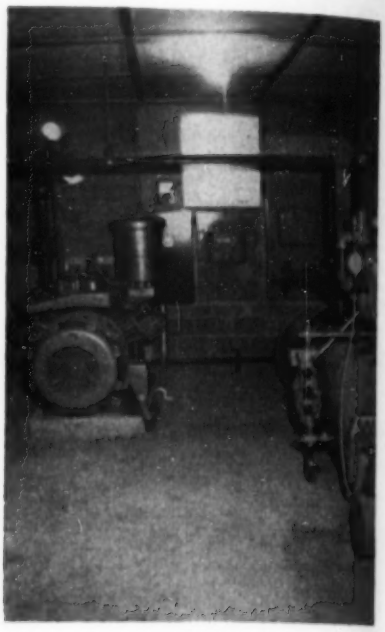
The schematic diagram shows the flow through the plant. The air to propane ratio is controlled by a Fisher diaphragm motor valve that acts as a ratio-regulator. The ratio of propane-air mix to the natural gas is controlled with similar equipment. The propane gas and natural gas are metered by Hagan dual meters and FRB (fixed ring balance) transmitters actuate the ratio-regulators that proportion the air to propane, and the propane-air to natural gas mixtures. The controls are installed to permit manual or automatic operation, and the adjustment and setting of the instruments involved are very simple and are permanent after once being properly made. Instrument air is taken from the air receiver.



LPG and air meters and proportioners.



Heat exchanger installation.



Air compressor and boiler.

Vaporization

The propane is vaporized in a heat exchanger supplied with steam at 10 psig from a gas-fired immersion-type boiler. It takes only 20 minutes for this boiler to generate the 10 psig of steam pressure from a cold start, so the plant can be put on steam in this short period.

Greenfield Gas Co.'s engineers feel that this station produces real advantages as follows:

(1) It can be put on stream very quickly.

(2) The control system is relatively simple.

(3) The equipment for the entire plant is easily installed.

(4) The equipment is easy to operate.

(5) Because of the simplicity of design, the station can be maintained properly with a minimum of effort.

Simplicity of design

In their opinion, this simplicity of design and the ease of operation are very important to any company contemplating peak shaving, but are particularly vital in the case of the smaller companies if the installation is expected to produce realistic economies.

As an illustration of the simplicity built into the Greenville station, the calorimetrical control is furnished by a Caloroptic burner that is tied in on the upstream side of the air-gas mix-natural gas ratio regulator to sample the propane-air gas before it is mixed with the natural gas. This device indicates the heating value of the produced gas, but control of the heating value is manual, by means of hand adjustment of the air-to-propane ratio-regulator.

Expansion

A 30,000-gal. tank was installed this year and there is plenty of area available at the site for the installation of additional storage capacity should the plant capacity require expansion. It is believed that plants designed on the basic precepts of Greenfield's will answer the requirements for small company peak-shaving operations. ■

GAS new products

To secure further information on products or new literature, simply fill out the coupon and mail, indicating by number the information or literature needed.

1 Digital Computer

Alwac III, latest in the line of digital computers produced by Logistics Research Inc. has been developed primarily for use by small commercial and technical organizations with large computational requirements.

With double the basic computing speeds of earlier Alwac computers, the new machine has 2048 additional words available in the main memory. Fast access storage has been increased from 64 to 128 words and provisions have been made for additional supplementary input-output equipment. Thirty additional commands have been added to the existing list.

Final results of computations are printed out with form control, signs, decimal points, and alphabetical headings completely under control of a sequence of instructions, permanently stored on the magnetic drum.

Logistics Research Inc.

■

2 Commercial Water Heaters

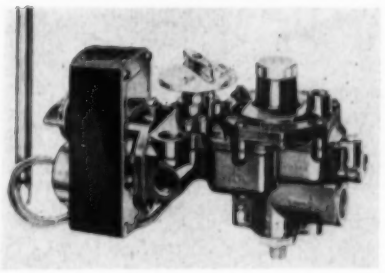
A completely new line of water heaters has been introduced by the Day & Night Division which have been designed for high volume needs in the commercial or domestic markets.

Known as the Coppertherm series, the new heaters are available in three models: as a basic boiler, a plug-in boiler room complete with pump and prewired controls, and one designed specifically for application as a swimming pool water heating system.

Prominent features include 100% rustproof copper waterways, Dual-Safe controls, a distinctive color scheme, and economical design with the accent on compactness and light weight.

Day & Night

■



3 Heating Thermostat Accessory

Perfect automatic control for any gas heating installation is provided in the new Model 55 Gasapack through use of the 55 MTS modulating snap thermostat accessory developed by the A-P Controls Corp. for use with its newly announced 55 Gasapack.

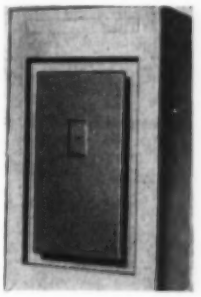
This accessory can be attached to the basic control by means of four screws and without the necessity of breaking the line. Operation is by means of a sensitive thermo-bulb. Unit then quietly snaps off when temperature maintained overrides requirements and low fire is no longer required.

The five controls that comprise the self-contained unit include a built-in pressure regulator for city gas, a large pilot filter, a 100% automatic pilot and main and pilot shutoffs.

A-P Controls Corp.

■

4 Commercial Cooling Units



The Coleman Co. has added two commercial self-contained cooling units to its line of packaged air-conditioning equipment. The new units are available in 3- and 5-ton capacities and are designed to meet the cooling requirements of commercial establishments.

Adjustable louvers concealed in the top of the unit give one- to four-way, draft-free air circulation in installations where air ducts are not used. Return air is admitted to the filter and cooling coil through concealed slots in the front panel of the unit. Automatic controls, exclusive of a wall-mounted

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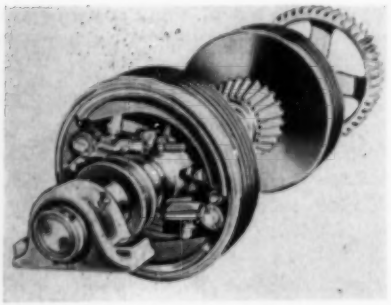
thermostat, are hidden by the hinged nameplate on the front panel.

Compressor, evaporator, condenser and all refrigerant connections are hermetically sealed at the factory into a single unit for protection against dust and moisture. Only three connections are required to operate the unit: water supply, electrical power, and a condensate drain for water removal.

Coleman Co. Inc.

■



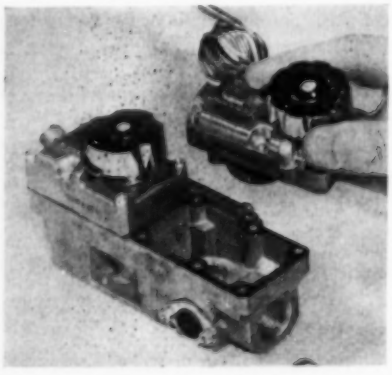
5 Improved Crane-Excavators

Fifteen major engineering improvements have been incorporated by Schield Bantam in its line of ⅜-cu yd, 5- and 6-ton truck and crawler-mounted crane-excavators. Model designation of the machines will be T-35A for the carrier-mounted and C-35A for the crawler-mounted Bantam shovel-cranes.

The improvements are: six-cylinder gasoline engine; two-shoe swing clutch design; cast steel drive tumbler for crawler; higher carbon and alloy content steel; double hook rollers; drum lock dog; bevel gear mounting, vertical track drive; bolt-on crawler side frames; track frame extensions; chain case brace; and tooth points.

Schield Bantam Co.

■



6 Valve-Pilot Control Package

A new valve and pilot control "package," which increases the flexibility of control systems while cutting inventory and installation problems, is announced by Minneapolis-Honeywell Regulator Co.

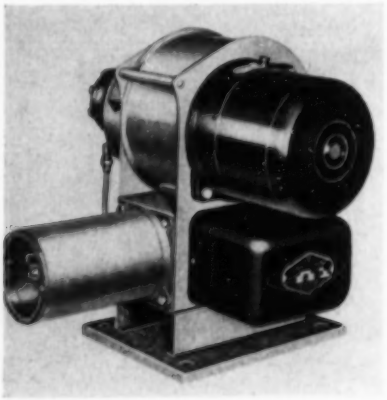
The new control, V5153 "Adatrol," includes a basic valve section on which Honeywell's gas cock "pilotstat" is factory-mounted. Models may be purchased with thermostats also factory installed or the unit can be supplied with a thermostat kit.

To add the thermostat it is only necessary to remove a blank plate from the basic valve and mount the thermostat with six screws. No other piping or special fittings are needed. The package control is also available with two other add-on features: a minimum rate high-low bypass assembly and a spring-loaded pilot filter. Both can be mounted by the equipment manufacturer or by the dealer in the field.

Range of the thermostat is 55 to 95°.

Minneapolis-Honeywell Regulator Co.

■



7 Conversion Burner

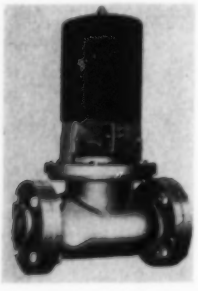
A new conversion burner for oil-fired installations has been placed on the market by American-Standard. The new Acroflame casting is made of steel. The burner includes NEMA motor, Sundstrand fuel unit, Jefferson transformer, and Torrington blower wheel.

Adaptable to any number of jobs, the burner is available with pedestal, hanger, and flange mountings. It is available with varying gun lengths so that it fits a wider variety of heating units.

American Radiator & Standard Sanitary Corp.

■

8 Motorized Valves



Motorized valves for automatic fuel control on gas-fired boilers, furnaces, ovens, kilns, and other gas combustion systems are being manufactured by Eclipse Fuel Engineering Co. Two-wire motor operator, soft neoprene seat construction, and sturdy lightweight aluminum body are features of the new valve.

The spring-loaded plunger and neoprene seat assure fast, positive shutoff in the event of electrical failure.

Eclipse Fuel Engineering Co.

9 Rotary Card Index

A new electrified rotary card index called the Kard-Veyer has been developed by Remington Rand Inc. for rapid reference and posting operations.

The Kard-Veyer contains movable shelves, which travel from either direction, bringing the required tray to the reference area from either above or below, stopping at posting level by automatic leveling. The operator doesn't have to leave her position at the unit because the Kard-Veyer, equipped with chair and posting board, forms a complete and compact work station at which the operator can perform all normal filing and posting activities.

Automatic leveling, shorter crosswise trays, two-directional carrier travel, and a rapid-action circuit system combine to give smoother, faster automatic filing with noiseless operations. The joining of clerk, records and filing cabinet into a single functional unit occupies less room and releases valuable office space for other purposes.

Remington Rand Inc.

■

10 Tape Wrapping Machine

Remco Manufacturing Co. has introduced a new type of power-driven tape wrapping machine, said to be the first

No woman ever cooked like this before!

NEW FLORENCE "GOVERNESS" BRINGS AUTOMATIC HEAT CONTROL TO TOP-OF-STOVE COOKING!

Now enjoy *automatic heat control* in the "neglected 80%" of all cooking . . . *the kind you do on top of your stove!* The new Florence Range "Governess" automatically holds food exactly at any pre-selected temperature, as it cooks, with no help from you! You can now do surface-burner cooking with the same sureness and convenience you enjoy in your automatic oven. You can do perfect deep-fat frying, sauteeing, griddle and pan frying . . . without scorching, sticking, or boil-overs . . . and without any extra gadgets or appliances! It's cooking luxury you've never dreamed of . . . with the exciting new Florence Gas Range "Governess."

No Scorching! No Sticking! No Boil-over!

JUST SET DIAL FOR PROPER TEMPERATURE AND THE "GOVERNESS" DOES THE REST!

It's so simple and easy! Just set the thermostat dial. Then the Florence "Governess" controls the flame, up or down, to maintain the food itself at the exact temperature you select, *automatically!* It ends pot-watching. It gives you *consistently* good french fried potatoes, shrimp or chicken, griddle cakes, bacon and eggs . . . dozens of other dishes . . . each done to unbelievable perfection every time! Ask to see a demonstration today.

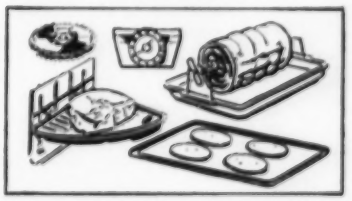
The "Governess" on your new Florence Gas Range makes your cooking obey, when you're away!

Guaranteed by Good Housekeeping

Let Florence do your cooking

NO EXTRA GADGETS NEEDED WITH THE FLORENCE "GOVERNESS"

Extra gadgets and appliances become unnecessary when you have a new Florence "Governess" Range. Any pot is a deep-fat fryer, any pan is a controlled-heat skillet!



FLORENCE IS FAMOUS FOR MANY QUALITY FEATURES

The "Governess" is the latest in a long list of Florence quality features. Ask to see the exclusive new 3-way Range Top, the new Harper-Wyman Alltrol Burners, the convenient Hi-Swing-Out Broiler and the famous Florence Roto-Broilercue!

NOW YOU CAN AFFORD A "GOVERNESS"

You'll be amazed at the low prices of the many handsome models shown at your Florence dealer. See them!

Florence®
GAS RANGES
SINCE 1874

Write for free folder on the new Florence "Governess" Gas Ranges
Florence Stove Company
Merchandise Mart • Chicago 54

DESIGNED for quick, low cost trench digging for foundations and all types of service lines.

LADDER type permits efficient operation in the closest quarters and under difficult conditions.

CUTS up to 5 ft. in depth in 8" to 12" widths; 4 ft. in 14" and 16" widths; straight and clean.

THE NEW BUCKEYE 403

For Fast, Low Cost Utility Ditching

The 403 is a small, easy-to-maneuver machine for digging water, gas, sewer, building foundations . . . Low bearing electric or telephone lines and for pressure to avoid damage to lawns or walkways . . . Easily transported from job to job and will travel over almost any type ground. Digs a clean, straight-sided trench with squared corners. Complete details from your distributor.

No. 5512

GAR WOOD INDUSTRIES, INC.
WAYNE, MICHIGAN

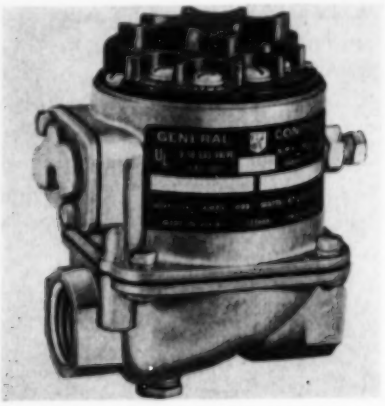
new products • *Cont'd.*

ever manufactured for commercial use. It is light, compact, and easily handled and can be used on 2-in. to 36-in. pipe. It will wrap tape and 15-lb felt or Kraft at the rate of 15,000 ft per day with a 3-man crew.

The Remco tape-wrapping machine is self-propelled, forward travel being synchronized with the wrapping head by a Linkbelt PIV unit. No change of sprockets is required when changing from one width of tape to another.

Remco Manufacturing Co.

■



11 Gas Control Valve

Among improvements incorporated in General Controls Co.'s B-50 gas control valve for gas appliances are greater gas capacity and smaller envelope size.

Designed for use in 24-volt heating control systems, the B-50 requires less than ½ watt of power. Further, B-50K, the latest model, is silent in operation and hum free.

The unit has a built-in screen through which all gas must pass before going over the valve seat. An optional UGI type high capacity gas filter protects the valve operator ports where gas is particularly gummy.

A spring-loaded diaphragm makes the new valve capable of operating in any position and assures tight shut off. The valve's multipoise feature plus its smaller size permit field and factory installation with maximum convenience.

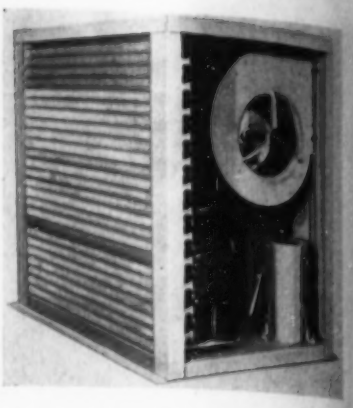
General Controls Co.

■

12 Cooling Units

Two new models of the Typhoon convert-to-cool air-cooled residential conversion unit are now being manufactured by the Typhoon Air Conditioning Co.

The new models are available in 2- and 5-ton capacities and consist of two separate sections: the cooling coil, which is installed right in the ductwork on top of a standard forced warm air



furnace; and the air-cooled condensing unit, which can be located anywhere outside the conditioned area. The condensing unit includes a hermetic refrigerant compressor and an air-cooled condenser. Extra-heavy cabinet metal reduces the operating noise level to a minimum.

An important feature of the Typhoon system is the extra-large condensing surface, which assures full-rated capacity even under extreme temperatures.

Typhoon Air Conditioning Co.

■

13 Tarpaulin Material

Haartz-Mason Inc. has introduced its new nylon and neoprene tarpaulin material, which will be marketed under the name, "Nylo-Tarp." The material combines the high strength of a nylon base fabric with the weather resistance and abrasion resistance of DuPont's neoprene. According to Haartz-Mason, this material is lighter than conventional tarpaulin materials and will give long life and service.

Haartz-Mason Inc.

■

14 Forced Air Heater

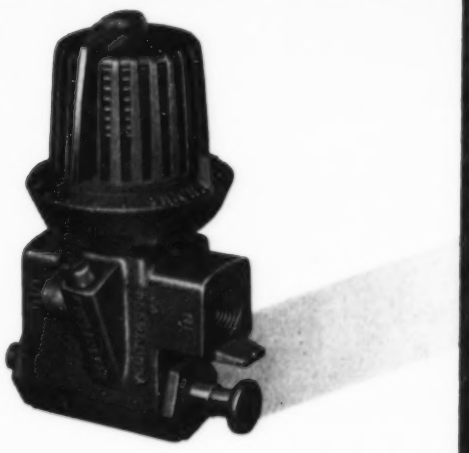
Williams Furnace Co.'s new Forsaire heating unit features the principle of counter-flow forced warm air circulation. Warm room air is salvaged, pulled in at the top of the unit by an 8½-in. dual inlet blower, forced down over the heating element and out through diffuser-type grilles to the floor.

Another feature of the gas-fired heating equipment is its compactness.

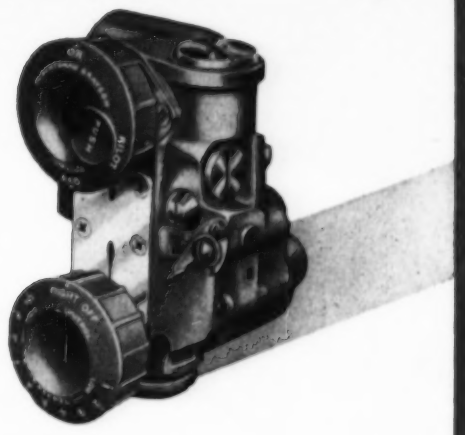
Williams Furnace Co.

Select the controls that help you sell MORE SPACE HEATERS

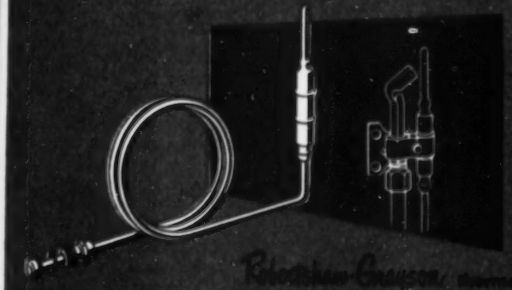
With Robertshaw®-Grayson automatic controls, thermocouples and pilots on Gas space heaters you sell, finest operating performance is assured. These dependable, accurate controls . . . nationally advertised for many years . . . have won complete consumer acceptance, thus giving you an *extra* selling feature.



MODEL 2EC is a throttling type heat control with adjustable by-pass set at the time of installation to maintain a minimum flame over the main burner at all times. It assures a more even distribution of heat and continuous air circulation that helps overcome the "cold 70°." It is equipped with thermoelectric automatic pilot that automatically releases to provide 100% shut-off if pilot failure ever occurs.



MODEL A17 UNITROL® Room Temperature Control is fully automatic. Powerful hydraulic temperature-sensing unit, located in "live" air stream of cold air intake, is extremely sensitive to small temperature changes. Completely installed *within* the heater, it requires no electrical connections, no chopping into plaster walls. Only two dials to operate. 100% operation; safe lighting, thermomagnetic pilot, pilot filter, built in gas cock.



Robertshaw-Grayson thermocouples and pilots belong together — because they're designed to work together.

Robertshaw-Fulton CONTROLS COMPANY

Grayson Controls Division, Long Beach, Calif.
Robertshaw Thermostat Division, Youngwood, Pa.
Robertshaw-Fulton Controls (Canada) Ltd., Toronto

GAS trade literature

15 Computer Brochures

Two brochures are available from Remington Rand Inc. (When ordering copies use number preceding description.)

(a) "Univac Service Routines" for use by programmers and designed to assist in the actual operation of the computer are briefly described in a new techniques - methods - applications brochure.

(b) "Break Through Your Cost Barrier" describes Remington Rand's computer for punched-card electronics, the Univac 120.

Remington Rand Inc.

■

16 Valve Bulletins

Ohio Injector Co. has issued two new bulletins. (When ordering copies use letter preceding description.)

(a) Valves for positive control of LP gas with cutaway drawings and specifications are described in Form 1002.

(b) Lubricated plug valves (semi-steel and steel) are described in Form 1003.

Ohio Injector Co.

■

17 Valve-Principles Booklet

Comic-book sequence is used by Barksdale Valves to explain the Shear-Seal valving principle in a new publication. The inside back cover of this book contains some cut-out working models and a cross section that further dramatizes the functioning of the Shear Seal principle.

Barksdale Valves

■

18 Compressor Catalog

A new 12-page catalog issued by Le Roi division of Westinghouse Air Brake Co. pictures all of the 40 models of portable-type compressors available. The quick reference chart shows the capacities, engine types, and mountings available.

Le Roi Division

■

19 Indicating Controller Bulletin

A new 12-page bulletin (5A-13) issued by the Foxboro Co. describes in detail the company's new Model 41A pneumatic indicating controller. The new proportioning mechanism is diagrammed and explained and typical applications are shown. Separate sections are devoted to temperature and pressure measuring systems.

Foxboro Co.

■

20 Jet Syphon Brochure

Steam and air jet syphons are described in a bulletin published by Schutte & Koerting Co. The bulletin discusses the application, construction, operation, and performance of jet syphons. Included are 17 tables on suction capacities, steam consumption, operation pressures, and sizes and dimensions.

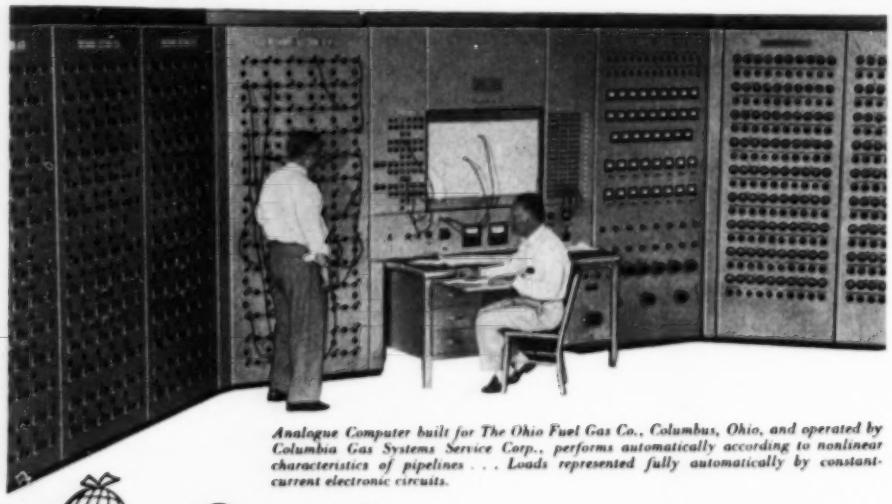
Schutte & Koerting Co.

■

21 Trencher Booklet

Engineering advantages of the all-new Model 60 Everett trencher are contained in a new booklet released by Earth Equipment Corp. Cartoon line drawings point out operational benefits of the trencher's new design and overall photos of the equipment in action are produced in the booklet as well as complete specifications.

Earth Equipment Corp.

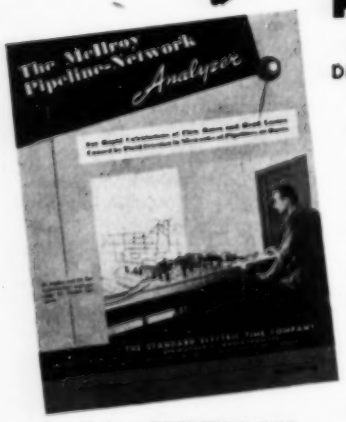


Analogue Computer built for The Ohio Fuel Gas Co., Columbus, Ohio, and operated by Columbia Gas Systems Service Corp., performs automatically according to nonlinear characteristics of pipelines . . . Loads represented fully automatically by constant-current electronic circuits.

Solve many of your difficult pressure problems

The McILROY FLUID NETWORK ANALYZER

Gives Immediate, Accurate Data, Quickly Solves Many Difficult Pressure Problems in Distribution and Transmission



Gas engineers will welcome the accurate data supplied automatically by the Analyzer, because with it they can decide with authority many baffling questions . . . The Analyzer is adjustable for all operating conditions . . . represents with satisfactory engineering accuracy operation of gas pipelines according to the Spitzglass, Weymouth, Panhandle, and other gas-flow formulas at low, intermediate, or high pressure . . . Solutions given for both compressible and incompressible fluids.

Send for BULLETIN 183

Your files should contain all available data on this very important development.

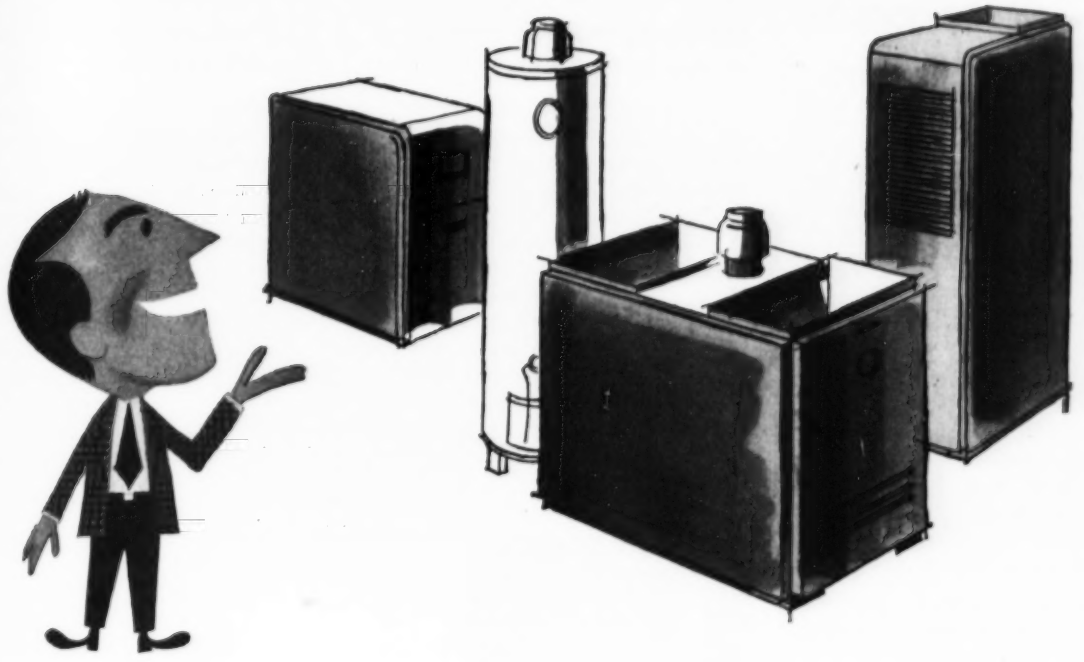
Since STANDARD 1884

The STANDARD ELECTRIC TIME CO.

125 Logan Street • Springfield 2, Massachusetts

ELECTRIC CLOCK AND PROGRAM SYSTEMS • FIRE ALARM SYSTEMS • HOSPITAL SIGNAL SYSTEMS
PRECISION TIMERS • CHRONO-TACHOMETERS

Sell the most complete line!



Furnaces, boilers, air conditioners—space, water and unit heaters! For every purpose, every purse—from one source. **BRYANT**, of course!

be "Mr. B"

(AUTHORIZED BRYANT HOME COMFORT DEALER)

Only "Mr. B"—the Bryant Home Comfort Dealer—has *all 8* of these selling assets to build his business BIG:

1. A name customers know and want
2. The most complete line of automatic heating, air conditioning, water heating
3. Quality equipment for every market
4. Exceptional distributor service
5. Professional sales training
6. Personalized selling tools for you
7. National advertising featuring you
8. Co-op "Mr. B" ads for local papers

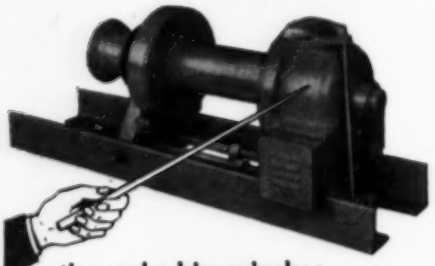
For bigger profits now, for a secure and prosperous future—see your Bryant Distributor. Ask him about Bryant's big "Mr. B" action program, and how it can make sales and money for you!

bryant®

AUTOMATIC HEATING
AIR CONDITIONING
WATER HEATING

NEW GAS news

12,000 and 20,000-lb. Gar Wood Winches



the only big winches with the lighter weight and better cooling advantage of all-aluminum housings

Choice of standard or low mount, plus all these other cost-cutting, performance-improved features:

- Fully-enclosed clutch to end sticking, rusting and freezing. Weather and dirt just can't get in.
- Clutch and all other moving parts running in oil. Insures long life, reduces servicing.
- Built-in rope clamp which gives better spooling, simplifies attaching and changing ropes. Shrouded drum flange ends danger of snagging. No U-bolts necessary.
- Self-energizing safety brake which automatically stops and holds full-rated load. Brake is air-cooled and easily adjustable.
- Worm shaft that turns in self-contained ball-thrust bearings. No bearing adjustment is needed.
- Base angles which are extra rugged to take many times winch's rated load.

You can be sure, too, these new winches will be your "best buy." Every part of them is quality-built and guaranteed by the world's largest manufacturer of commercial and military winches.

GW-W-4

Mail coupon for all the facts.

Gar Wood Industries, Inc.
Main St., Wayne, Michigan

Send free literature on:

☐ New 12,000-lb. Winch ☐ Std. Mount
☐ New 20,000-lb. Winch ☐ Low Mount

Name .....
Title .....
Company .....
Address .....

Washington gas firms in merger talks

Merger of the Seattle Gas Co. and the Washington Gas & Electric Co. is being discussed. A decision may be reached within about a month.

"All phases are being studied," said Walter S. Byrne, president of Seattle Gas, and E. A. Peyser, president of Washington Gas & Electric.

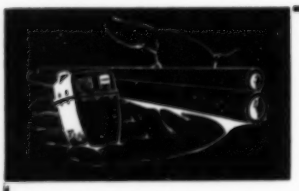
"This matter is purely in the discussion stage. Some definite word should be available by the end of April."

The two men said July next year is the target date for distribution of natural gas in the Puget Sound area served by the two firms.

Montana utilities request rate case rehearing

Montana's supreme court was asked by two utility firms to reconsider its recent decision that the state attorney general has the power to challenge rate increases granted by the state PSC.

Mountain States Telephone and Telegraph Co. and the Montana Power Co. sought rehearings of two companion cases that the high court ordered back to the Lewis & Clark County District Court for further trial on their merits. State Attorney General Arnold H. Olsen brought both of the suits in an attempt to block telephone and natural gas rate increases approved by the PSC.



SHORT CUTS IN MATERIALS HANDLING: **10**

Drum-handling extension arm

AGA materials handling subcommittee.

Southern Counties Gas Co., Los Angeles, uses this special fork-lift extension arm for a 4000-lb fork lift truck to unload drums of enamel, two at a time, from a box car. It has also been used effectively for handling large valves, rectifiers, etc. The extension arm is constructed from standard shapes according to a design originated in the SoCounties stores department and developed by company engineers in the construction and distribution department. It is designed for 1500-lb loads with a 3000-lb full swivel hook and grabs. According to the company, the attachment has paid for itself many times over because of the more rapid rate of car unloading and drum stacking.

Range Top Burner Ignition

MICRO-LITE

—a tiny pilot at each burner

- **Instant, positive ignition**
- **Range top stays cool**
- **Thrifty, trouble-free operation**

Here's a wonderful new gas range feature that lends itself to effective demonstration for **plus** sales! The MICRO-LITE provides at each burner a tiny pilot flame smaller than the head of a paper match . . . a stable flame on the point of a small hollow needle. The instant gas starts to flow from the Center Simmer section ports, it is ignited by the MICRO-LITE pilot. There's no lag! Besides providing faster ignition, MICRO-LITE requires no more gas—and often less—than ordinary flash-tube types!

HARPER-WYMAN COMPANY

DEPT. H55-G • 8562 VINCENNES AVENUE • CHICAGO 20, ILLINOIS

ORIGINATORS OF CENTER SIMMER BURNERS

for the two utilities.

Montana Power contended in its rehearing petition that the high court overlooked certain sections of state law in ruling that Olsen had the right to bring the case "solely on the authority of the decision" in the telephone case.

The utility also questioned the validity of references to other cases on the common law rights and duties of the attorney general because they involved questions of whether the attorney general has well-established common law rights.

Word-of-mouth influence used in heating campaign

The value of word-of-mouth communication is going to be tested by Consolidated Edison Co. of New York this year in its residential gas house-heating campaign.

Up until now, ConEd feels that gas sales for residential space heating have been impeded by widespread public misunderstanding as to the relative cost of gas in comparison with other fuels, particularly oil.

"Our biggest job is to correct this impression," stated C. M. Meytrott, assistant vice president, at the preview of the 1955 heating campaign held recently. "Until we succeed, it will be difficult for us in the sales department to sell gas in such an atmosphere of confusion."

Making a movie to help sell residential gas househeating — This scene is from ConEd's new sound-color movie, "Hey, Charlie!"

Before setting up this year's program, ConEd reached the conclusion that the mass market, which it is trying to reach, breaks down into a series of groups, each exerting a tremendous influence over its members. This group influence determines not only what they do but what they buy. The fate of a product in a group depends on the message carried by word-of-mouth among the members of the group. If a favorable impression can be imposed on the communication system, the sales among the group will increase.

ConEd will use leaders in the groups, who were determined last year by a canvass conducted by the company.

Here, in ConEd's film, Homeowner Peggy Cullen show her friend how nice her basement looks since the old oil burner has given way to trim, modern gas space and water heating equipment and the entire area has been converted into a playroom.

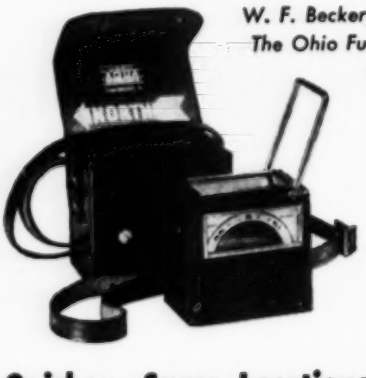
No Stooping!

"...no needle nervousness...pinpoint accuracy.

THE NEW AQUA VALVE BOX LOCATOR

has our unqualified approval!"

W. F. Becker, Chief Inspector
The Ohio Fuel Gas Company
Columbus, Ohio



Quicker, Surer Locations Every Time

The miraculous new Aqua Valve Box Locator makes obsolete all previous types. New design, perfected after two years of engineering research means **absolute minimum of needle spinning action.**

The new Aqua Extra Conductor development makes failure practically impossible, and it is **exclusive in the location instrument field!**

- New exclusive "Electric Braking" action
- Top-view reading. No stooping.
- Factory adjusted to your geographical location
- New high impact Styron plastic case virtually indestructible
- Compact, convenient, non-variable
- Guaranteed to function regardless of ground cover

$29.50

f.o.b. Cincinnati
Your Name in Gold Free

FREE 15 DAY TRIAL

No Money! No Obligation! You be the judge.

AQUA SURVEY & INSTRUMENT CO.
2016 Worth Avenue Cincinnati 12, Ohio

Mail this Coupon for FREE Trial or Literature

Gentlemen: Please send me
☐ New Aqua Valve Box Locator for FREE 15 day professional trial, without obligation.
☐ Detailed literature on new Aqua Valve Box Locator.

NAME.....
COMPANY.....
STREET.....
CITY.....ZONE.....STATE.....

JOHN WOOD Automatic GAS water heaters COST LESS TO OPERATE AND YOU CAN PROVE IT!

It's SAVINGS that make sales

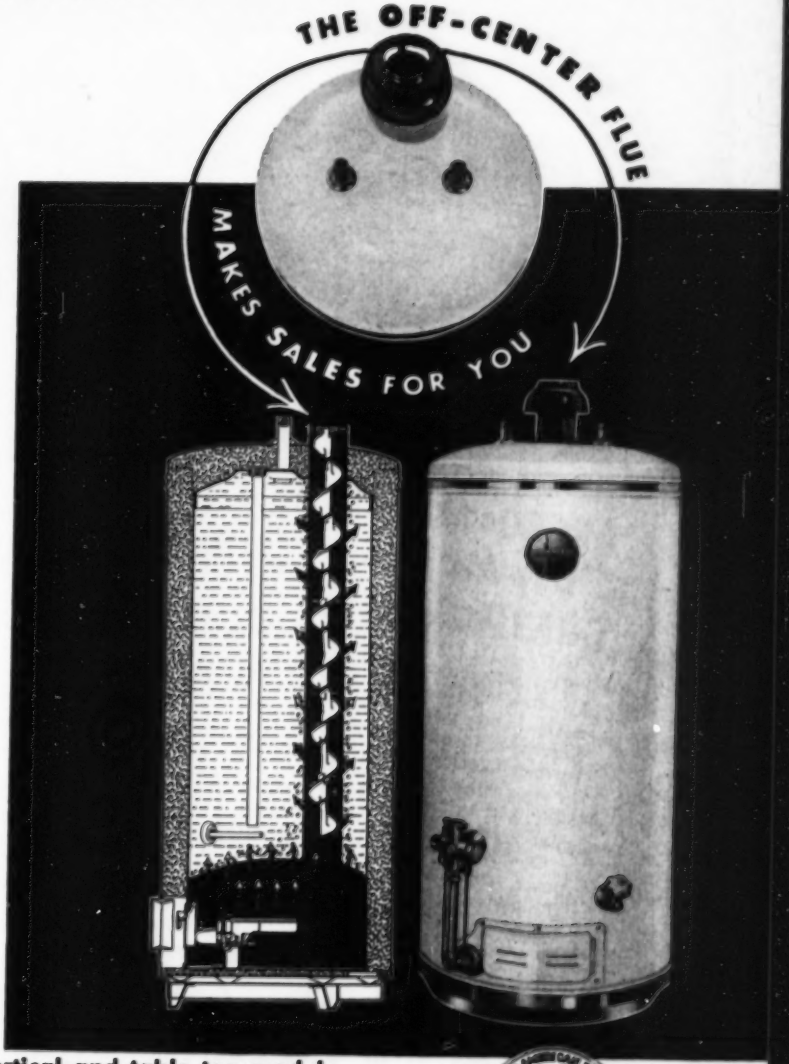
It's here—ready to work for you! JOHN WOOD has a water heater story that's a natural for sales! BY ACTUAL TEST, John Wood Water Heaters cost your customers less per gallon for hot water ... make *savings no other construction can match!* That's because the OFF-CENTER flue construction—developed and featured by JOHN WOOD—beats every known water heater construction for economy in test after test.

That one fact gives you a real edge on all your competitors. Nobody has an economy story like yours when you feature JOHN WOOD. *Nobody* has the profit chances you get with the proved JOHN WOOD economy story!

Here's potent sales material—backed up by the hardest hitting program of promotion and advertising yet—*all working for you and your bigger profits.*

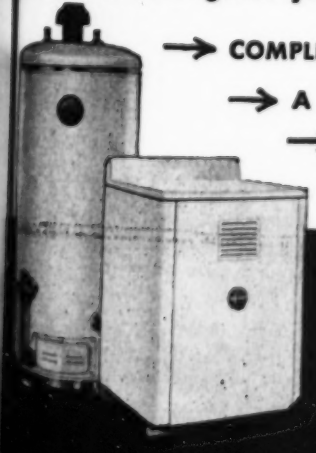
Ask your JOHN WOOD representative for the full story.

Write for FREE Book "How Do You Judge a Water Heater"—Today!



BEATS the rest by EVERY test

JOHN WOOD gives you more to build sales—



- **COMPLETE LINE of sizes and styles, vertical and table top models**
- **A PRICE FOR EVERY BUDGET**
- **THE ONLY WATER HEATER OFFICIALLY SELECTED BY *Mrs. America***
- **FULL PROMOTIONAL HELPS to build your sales**

Finest glass-lined or galvanized water heater anywhere!

JOHN WOOD COMPANY
HEATER AND TANK DIVISION
Conshohocken, Pennsylvania and Chicago, Illinois

The word-of-mouth communication has made gas sales for new homes in Westchester so acceptable that three out of four new homes are gas heated. In Queens the same communication network has worked against gas so that the company gets far fewer new gas-heated homes.

Another important factor in the group is the community leader's influence. Now that ConEd has this basic leadership idea (in addition to evidence that it works), the question arose as to how to get the leader and her friends to listen to the gas house-heating pitch in her home.

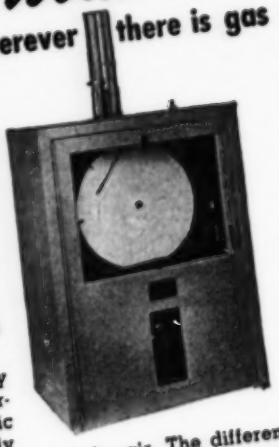
To do this the company has produced a sound color movie designed to sell gas space heating in an entertaining manner. A specially selected and trained group of ConEd girls will call on each of the leaders for the purpose of setting up an afternoon tea party to which the neighborhood leader will invite her friends and neighbors and at which the movie will be featured. Preliminary field testing has proved to the company that the plan will work.

ConEd believes that the movie, better than any other form of sales presentation, will hold the attention of the group and, because of the viewer's normal concentration on a movie, will leave no doubt that gas is the service with many advantages that costs less.

In addition, ConEd is putting into the field more than 100 business representatives to sell jobs for the installing plumber's account at a price that will give him a profit. Newspapers, television, and radio will be used in Westchester in addition to billboards and car cards.

ARCCO

The World Over
—wherever there is gas



ARCCO-ANUBIS 'Dry-Air GAS GRAVITOMETERS

This new Arcco-Anubis Dry Air Gas Gravitometer determines and records specific gravity of gases automatically corrected to the humidity content of the air. The difference in weight between a column of GAS and equal column of DRY AIR is measured. This ratio represents the true specific gravity of the sample.

One bell of the instrument is filled with gas which is being measured, and the other bell is filled with dry air. Otherwise, except for the new instrument having one column for gas and one column for dry air, the unit is identical in operation to the standard gas gravitometer. When calibrated and properly installed, these instruments require little attention other than to wind the clock, ink the pen, and change the chart. Send for bulletin No. 101.

AMERICAN RECORDING CHART CO.
3113 E. 11th St. • Los Angeles 23, Calif.

Available for Early Delivery

SEND FOR BULLETIN NO. 101

Oregon bill would require certificate of convenience

A bill to require a new gas or pipeline company coming into a territory to get a certificate of convenience and necessity from the state public utilities commissioner has been given final passage by the Oregon Legislature and sent to the governor for signature.

The measure stems from prospective piping of natural gas into Oregon, according to Rep. George Layman of Newberg and chairman of the House judiciary committee, who said it was needed to keep an importing company from "skimming the cream" of the gas business by unregulated selling to large industrial plants.

At an earlier hearing before the Senate commerce and utilities committee, Francis Hill, representing the Portland Gas and Coke Co., said his firm wanted to be able to reduce its residential and small commercial rates when it got natural gas within the next year or two, by taking advantage of the opportunity to sell interruptible loads to industrial consumers.

Portland's vice president, Wesley A. Cook, said the bill would not prohibit a new company from serving an area currently not supplied with gas. It would only restrict the right of a company to move into an area already being served.

Gas companies backing kitchen modernization

Utility companies representing 75% of the nation's gas meters currently have 280 New Freedom gas kitchen and laundry displays on their main sales floors or at their branch offices.

The trend toward expanded kitchen and laundry programs by gas companies was emphasized in a survey made recently by the New Freedom Kitchen & Laundry Bureau of the AGA.

Modernization of existing displays to highlight built-in gas units was stressed by a majority of companies participating in the survey.

Although AGA's kitchen program was inaugurated in 1944, the compa-

nies have kept pace with appliance innovations with up-to-date displays. The majority of the utilities' displays, according to the survey, are only a year old, or less. Only three of the companies replying had displays older than five years.

Kitchen planning services are being offered on the sales floors of 42% of the companies replying to the survey. Sixty-seven of the companies are cooperating with cabinet dealers in offering customers a kitchen planning service, while 65% work with cabinet manufacturers in selling to the builder field. At the same time, 60% of the companies work with local dealers in exchanging kitchen and appliance sales leads.

Underground storage plans made by Pennsylvania

Plans to use depleted Pennsylvania natural gas fields as underground storehouses for surplus gas from the Southwest have been announced by Governor Leader.

To effectuate it, he appointed Dr. John C. Calhoun Jr., professor of petroleum and natural gas of the Pennsylvania State University, to the staff of the state department of forests and waters.

Pointing out that the plan would insure continued revenue from leases and royalties, Governor Leader said the plan involves using abandoned wells to store gas piped in from Texas and other states during the summer slack season and then piping it out during peak demands of the winter for use in the northeastern section of the country.

The plan also involves creating a new bureau in the department that will be headed by two paid specialists, a geologist and a natural gas expert, neither of which have been chosen.

Objections raised to plan for Minnesota commission

Strong opposition has been expressed by the Minnesota Railroad and Warehouse Commission against Governor Freeman's proposal to strip the agency of much of its power and to make members appointive instead of elective.

"It is our judgment," objected the commissioners, "that the interest of the public can be served best by having the commissioners elected by the voters and responsible to them."

Governor Freeman recommended that the Legislature abolish the commission as an elective agency and place its rate-making functions in a new three-member state public utilities commission appointed by the governor.

How a Sherman Power Digger Does More Work in Less Time with No Standby Equipment

Nearly every department in the city of Hopkins, Minnesota, finds a use for this versatile Sherman Power Digger.

The Water Department uses the machine when cutting off discontinued service lines at the main. They dig a hole in the street (usually blacktop) 3′ wide by 6′ long by 8′ deep. The hole must be plumbwalled for minimum replacement of paving. This operation used to tie up a truck all day, an air compressor half a day, and two men with hand tools, a full day.

Using a Sherman Power Digger, they now do *three* such jobs in one day, with only one man on the digger, no truck, and no compressor, except for concrete pavement. The job goes faster because they can dig the hole, shut off the line, and backfill before the walls begin to cave. Local soil conditions formerly required cribbing many of these excavations.

If *your* work involves the construction or maintenance of underground facilities, you will profit with a Sherman Power Digger. It's compact, fast, and flexible, with low initial cost and amazing economy of operation. Write today for full details, without obligation. Ask for Bulletin No. 412.

SHERMAN FORK LIFT
•
SHERMAN POWER DIGGER*
•
SHERMAN FRONT END LOADER

Sherman
PRODUCTS, INC.
ROYAL OAK, MICHIGAN

*DESIGNED, ENGINEERED AND MANUFACTURED JOINTLY BY SHERMAN PRODUCTS, INC., ROYAL OAK, MICHIGAN, WAIN-ROY CORPORATION, HUBBARDSTON, MASS. PATENT NO. 2,353,851 OTHER PATENTS PENDING. © SHERMAN PRODUCTS, INC., 1955

Pittsburgh firms boost built-in gas ranges

Along with springtime flowers, the natural gas companies serving the Greater Pittsburgh area—Equitable Gas Co., the Manufacturers Light and Heat Co., and the Peoples Natural Gas Co.—have blossomed out with a tremendous three-way bonus plan to boost sales of built-in gas ranges.

At a dinner-display gathering at Pittsburgh's Hotel Webster Hall, the promotional campaign was outlined to 218 authorized manufacturers, distributors, and dealers of kitchen cabinets.

E. W. Wesland, manager of built-in range sales for Caloric Range Corp., spoke for the built-in gas range manufacturers on the topic of old home modernization through the advantages of built-in gas ranges; and Edward Stevenson, field coordinator of Peoples Natural, presented the campaign details.

The plan, as explained by Mr. Stevenson, is a threefold bonus plan in actual money, with a fourth built-in bonus being a powerful promotional advertising campaign.

The fourth bonus, the promotional advertising campaign, will utilize the major publicity media in the Pittsburgh area. Full-page ads in the three metropolitan Pittsburgh newspapers will be followed by five-column ads; more than 200 announcements will be made on two of Pittsburgh's popular radio shows; and commercials will appear on television for the entire campaign period.

As a specific illustration of the value of promoting and publicizing the built-in gas ranges, Mr. Wesland made note of recent sales resulting from installation of the ranges in model homes in the Pittsburgh area. Builders and prospective buyers of new homes have been impressed enough to warrant the installation of built-in gas ranges in many of the new homes constructed in the Pittsburgh area.

SEC survey shows 4% gain in 1955 utility outlays

New plant and equipment outlays this year are expected to total approximately $27 billion, slightly above 1954 expenditures, according to the annual survey of business anticipations conducted in February and early March by the SEC. Capital expenditures are expected to turn up in the second quarter of this year, ending a decline that began in late 1953.

Investment programs of public utilities and commercial companies (including communications) show the greatest strength in 1955, with scheduled increases of 4% and 7% respectively.

Public utilities are expected to spend $4,384,000. The 4% rise indicated is attributable entirely to a sharp increase now planned by gas companies, in large part for new pipeline construction. Electric utilities anticipate maintenance of last year's rate.

AGA sees 1.4 billion expenditures in 1955

The nation's gas utility and pipeline industry spent $1.1 billion during 1954 for construction of new facilities and expansion of present plant. The industry anticipates the expenditure of an additional $1.4 billion during 1955, the American Gas Association estimates.

Although falling short by $87 million of an estimate made by the AGA Bureau of Statistics early last year, the expenditure for 1954 marks the fifth successive year that $1 billion or more has been spent on construction of gas facilities. Some new pipeline projects anticipated for 1954 were deferred until 1955.

meet George Briggmann*

. . . a member of CARBIDE's *CARBOSEAL Anti-Leak staff*—with a gas crew and a camera crew, shooting scenes for the movie "CARBOSEAL Anti-Leak Stops Gas-Main Leakage." In 15 minutes, this film shows you the ease, economy, and effectiveness of CARBOSEAL Anti-Leak in stopping leakage due to dried-out fiber packing.

There's a lot of George's valuable experience in this 16 mm. color-sound film. And we'll be glad to lend it to you—just write to:

CARBOSEAL ANTI-LEAK

Carbide and Carbon Chemicals Company
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N.Y.
In Canada:
Union Carbide Canada Limited, Toronto

"Carboseal" is a registered trade-mark of Union Carbide and Carbon Corporation.

A SMALL BASO® VALVE with big-vo

● The Type 843 Baso Valve provides safe lighting, complete shut-off of gas, and built-in plug valve for all small gas appliances with capacity of 60,000 Btu./hr. or less: **Wall Heaters • Room Heaters • Deep Fat Fryers • Coffee Urns • Griddles**

In an overall length of less than 3¾", this straight-through Baso valve offers plug valve control of main burner and pilot burner gas, safe lighting, and complete shut-off of all gas if the pilot burner should be extinguished. Its small, compact size brings all the control features of its larger brothers to the small capacity appliance where limited space may be a controlling factor in the selection of an automatic pilot valve.

The cocky, red plastic handle turns through only 180° from the Pilot to the Off position. The multiple cross drilling of the plug valve control both main and pilot burner gas. Resetting of the valve can be accomplished only when the handle is at the Pilot position and when gas can reach only the pilot burner. A built-in pilot adjustment feature allows quick and easy adjustment of pilot burner gas. Inlet and outlet are ⅜" female pipe threads and pilot opening ¼" compression coupling. The electromagnet hood and reset assembly is replaceable in the field.

The price? Just what you're looking for—small, like the valve. Write . . .

MILWAUKEE GAS SPECIALTY CO., Dept. SC-5, Milwaukee 1, Wis.

Anticipated expenditure of $1.4 billion this year marks 1955 as the second largest construction year in dollar magnitude in history. In 1951, a total of $1.46 billion was spent. The new estimate for 1955 is about one-quarter billion dollars higher than was estimated a year ago for the current year. The increase reflects among other porjects, the start of two new pipelines having a total cost of $290 million: the $160 million linking the San Juan basin to markets in the Pacific Northwest and the $130 million line from Louisiana to the East North Central region.

Gas industry constduction expenditures have increased more than 10-fold since the pre-war years. Such expenditures have risen from an average of $799 million in the five immediate post-war years following 1945. In each of the years since 1950, the nation's gas facilities have been increased by the expenditure of $1 billion a year or more.

Industry estimates for 1954 and 1955 were derived from expansion of responses provided by reporting companies. Tabulated construction expenditures for gas utility and pipeline construction in millions of dollars follow:

Average 1937-1941	$ 101
Average 1946-1950	799
Total for 1951	1462
Total for 1952	1067
Total for 1953	1350
Total for 1954 (preliminary)	1108
Total for 1955 (estimated)	1395

Texas A&I announces 10th annual short course

The 10th annual short course in gas technology to be held at Texas A&I College under sponsorship of the Southern Gas Association will be held June 1-3 at Kingsville, Texas, according to Dr. Frank H. Dotterweich, director of the college's division of engineering.

The course is divided into two parts —one concerned with gas production and conditioning, the other with transmission. Enrollment is held to 150 persons.

R. C. Granberry, petroleum engineer at Humble Oil & Refining Co., is chairman of the production and conditioning section. H. F. Steen, vice president and general manager of El Paso Natural Gas Co., is program chairman for the transmission section.

Saskatoon gas system to be expanded this year

The Saskatchewan Power Corp. will extend its Saskatoon natural gas system this year to serve the city of Prince Albert and a number of smaller communities in the northern part of the province. Work is expected to commence this spring.

Two phases are involved. In one case, the company will build a 14-in. pipeline from the Coleville gas field to Biggar and Saskatoon; in the second phase, work will start simultaneously to build another pipeline from Saskatoon to Prince Albert via Dana, Wakaw and Cudworth.

The 115-mile pipeline from Coleville to Biggar and Saskatoon would probably be a 14-in. pipe, and will be designed to eventually serve a number of communities en route.

This section of the pipeline will hold special significance for the city of Saskatoon, as it will not only open a new market for gas in the area southwest of the city, but will also serve as a loop to supplement the original pipeline build from Brock to Saskatoon in 1954. With this double line entering the city, customers in Saskatoon will have almost complete security with respect to continuity of gas supplies.

A 12-in. pipeline is to be build from Saskatoon to Dana, to provide for future eastward extensions and a 10-in. one from that point northward.

YOU NEED

PROTECTO WRAP...

FOR THE FAST, EASY AND ECONOMICAL COATING OF FIELD JOINTS, GAS SERVICE FITTINGS AND MECHANICAL COUPLINGS

PROTECTO WRAP is a hot applied protective coating in roll form for field joints on mill or yardcoated pipe, fittings, couplings and other metal surfaces exposed to above and below ground corrosion.

PROTECTO WRAP consists of a plasticized coal tar or asphalt enamel, of the types used for pipeline coating, saturated into a glass fabric that acts as a carrier and reinforcement for the enamel. PROTECTO WRAP is interwoven with a paper separator that insures even distribution of the coating as well as easy unwinding, regardless of temperature. The material is used to coat mteal surfaces where the quality of hot applied reinforced bituminous coating is desired.

PROTECTO WRAP is available in 2, 4 and 6 inch widths, fifty feet in length; and in 18 and 24 inch widths, 30 feet in length.

Our sales representatives are available to demonstrate this material and method. Address your orders or inquiries to our nearest sales office or to 2255 South Delaware Street, Denver, Colorado.

1406 JEFFERSON AVENUE, HOUSTON, TEXAS
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PROTECTO WRAP COMPANY
DENVER, COLORADO

High sales level seen for gas water heaters and dryers

Sales of automatic gas water heaters during 1955 could reach a level of 2.85 million units, under optimum conditions of product design and sales promotion activities, and with economic conditions remaining at 1954 levels. Potential sales of 16.5 million units are indicated in the five years ending in 1959, according to studies by the American Gas Association. If automatic gas water heaters maintain only the present degree of consumer acceptance, and business conditions remain unchanged, sales during 1955 should aggregate 2.35 million units, and a total of 12.8 million units will be sold during the 1955-1959 period.

Total potential sales of automatic gas clothes dryers during 1955 are estimated at 300,000 units, with the maximum of sales promotion effort and product design. Gas incinerator sales could total 140,000 units under these conditions if 1954 economic levels prevail. For the 1955-1959 period potential sales of automatic gas clothes dryers are estimated to be 2.2 million units, while sales of gas incinerators could rise to 1.2 million units.

If consumer acceptance should continue at present levels and business conditions remain unchanged, sales of gas clothes dryers and gas incinerators during 1955 should amount to 250,000 units and 110,000 units respectively. The corresponding totals for the five-year period would be 1.65 million gas clothes dryers and 700,000 gas incinerators, at present promotional and economic levels.

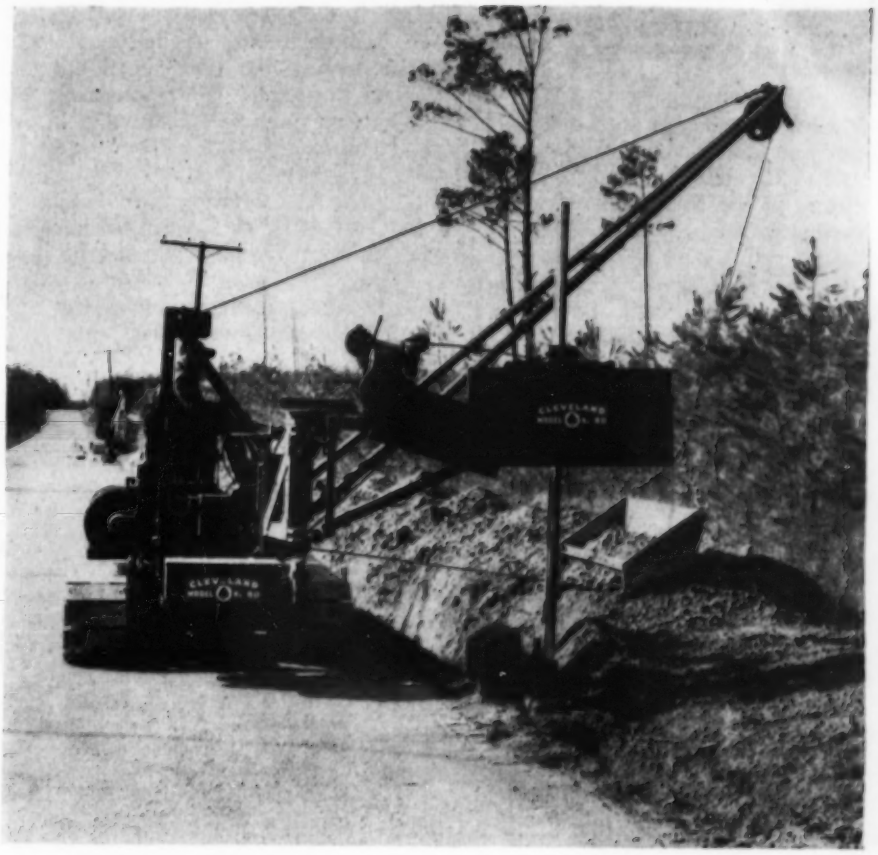
Utilities commission opposed in Iowa

Members of the Fort Dodge (Iowa) city council are opposing a bill in the Iowa house of representatives to establish a state public utilities commission.

The house bill calls for creation of a utility commission of three members, appointed by the governor. The commission would have jurisdiction over the rates charged by privately owned electric and gas utilities.

The Fort Dodge council protests that the bill would allow utilities "to impose automatic increases in rates without the approval of the commission or without affording an examination of the company's earnings." Also, that a section of the bill "imposes on the consumer a duty to sue for any rebates that may be coming to him as a result of final rate determinations."

The council's statement objects to using "present fair value in determining the basic value of a plant for rate-making purposes."



Saves 6 men, 4 tampers, 2 compressors and small dozer with one-man-operated "80-W"

VAN DOREN BROTHERS of Richmond, Virginia recently backfilled and compacted approximately two miles of trench, 2 feet wide and 4 feet deep, for a 6-inch gas line with just one man and one machine, a Cleveland "80-W" backfiller.

Before the Van Dorens purchased their "80-W" they used 7 men, a rubber-tired dozer, 2 compressors and 4 air-driven tampers for backfilling and compacting on jobs of similar size and type. The one-man-operated "80-W" did the complete job in less time than the 7-man crew formerly required on comparable jobs. "It's a great time saver," was F. M. Van Doren's comment on its performance.

On a previous job their Cleveland backfiller had saved them considerable time and money on a 12-inch water line trench, averaging approximately 6 feet deep, by its unique ability to backfill spoil deposited on a down slope on the far side of the trench, while simultaneously tamping it to the state of Virginia's rigid compaction specifications.

The "80-W" also does an outstanding job of side-crane work, lays pipe, pulls crossings, sets hydrants and valves, pulls sheathing, loads and unloads pipe, etc. Despite its ability to perform all these operations—and do an outstanding job on *each* of them—the "80-W" is easy to operate. The Van Dorens' operator learned to operate it with high efficiency after only two days training on the job.

Investigate this remarkable time, labor and machinery saving tool now—so that you, too, can realize its outstanding benefits on your next job.

See your local distributor for the full Cleveland story or write direct to:

THE CLEVELAND TRENCHER COMPANY • 20100 St. Clair Ave., Cleveland 17, Ohio

CLEVELAND

GAS news notes

Omaha's mayor has appointed a 15-man committee to study Northern Natural Gas Co.'s offer to purchase the gas facilities of the Metropolitan Utilities District of Omaha.

Four fellowships for graduate students in the Department of Petroleum and Natural Gas Engineering have been announced by the College of Mineral Industries, Pennsylvania State College, University Park, Pa. The fellowships are the Gulf Research & Development Co. grant in petroleum and natural gas engineering, the Continental Oil Co. grant in petroleum engineering, the Stanolind Oil & Gas fellowship in petroleum engineering.

According to Public Service Electric & Gas Co., Newark, a bill has been introduced in the New Jersey legislature to put a ceiling of 7½% on gross receipts taxes paid by electric, gas and sewerage companies in the state.

Binghamton (N. Y.) Gas Works has renewed a request to be allowed to vary its rates to correspond with changes in the cost of gas from suppliers. The appeal for the escalator provision has been addressed to the public service commission.

Southern Indiana Gas & Electric Co. has made application to the public service commission of Indiana for authority to issue 2500 additional gas space-heating permits. These additional installations will increase the proportion of gas heating customers to approximately 67% of the company's total 39,000 gas customers. The company's new underground gas storage field, west of Evansville, has been in active operation during the present winter and has enabled the company to meet and supply a new peak 24-hour delivery of 52,830,000 cu ft.

Grange Chemicals Ltd., a new company for the manufacture of detergent Alkane, has been formed by Oronite Chemical Co. of San Francisco and British Petroleum Chemicals Ltd. of London. The new company will commence operations on completion of its plant, now under construction at Grangemouth, England.

Consumers' Gas Co. has started construction on a $380,000 pipeline to carry natural gas to Brampton, as part of an expansion program that will see gas lines brought within a half-mile of any prospective housing or industrial development in metropolitan Toronto.

Completion of an agreement under which Twin Coach Co. will purchase all of the outstanding stock of Davey Compressor Co. has been announced. The Davey Compressor Co. will continue to operate with present personnel and management as a wholly owned subsidiary of Twin Coach Co.

A four-year, tuition-paid scholarship to study electrical or mechanical engineering at Carnegie Institute of Technology is being offered by the Robertshaw Research Center, Robertshaw-Fulton Controls Co.

The scholarship, which has an estimated value of $2820 plus a $100 cash prize for the winner, will be awarded to an outstanding high school senior from Westmoreland county, Pa.

As part of the special celebration marking the installation of the 200,000th meter on its lines, Alabama Gas Co. installed a specially built gold plated meter supplied for the occasion by American Meter Co., at the home of Mr. and Mrs. Gordon Sharpless of Anniston. The Sharpless family were also awarded their choice of any major gas appliance to mark the occasion.

BETTER
BEST
When it comes to the diaphragm data in your meter service records, you'll see better over-all accuracy and longer service life with Lancaster Groove Type Metal Rim Diaphragms in your meters.
From the groove type design which assures equal leather at both "in" and "out" stroke extremes . . . to the fine specially processed leather itself, Lancaster has the edge in practical engineering, quality materials and precision workmanship.
Send for a sample and see for yourself
METER PARTS CO.

GAS current reading

INTER-INDUSTRY INVESTIGATION, ESSENTIAL CHARACTERISTICS AND PROPER INSTALLATION METHODS FOR PROTECTIVE DEVICES FOR DOMESTIC STORAGE-TYPE WATER HEATERS REGARDLESS OF THE ENERGY USED FOR HEATING—This second and final publication on Domestic Gas Research Project DGR-5-WH presents briefly the findings of this investigation and the recommendations of the inter-industry coordinating committee.

Sections of the report are devoted to thorough discussion of the conditions that may create the need for relief devices, the types of controls required to prevent potential hazards, and proper methods of applying such devices. Properties of control devices are carefully examined to establish minimum performance characteristics necessary to insure proper protection being given by these devices. In addition, the possible effect of various environmental conditions upon the operating characteristics of relief devices is also considered.

Project DGR-5-WH was sponsored as a PAR plan activity of the AGA committee on domestic gas research.

Copies of the report may be obtained for $1 each from the AGA Laboratories.

MOST CRITICAL INDUSTRIAL OPERATIONS AND APPLICATIONS WHERE UNINTERRUPTED GAS SERVICE IS ESSENTIAL TO THE TECHNOLOGY OF THE PROCESS—Information Letter No. 68 of the AGA industrial and commercial gas gas section was prepared in an attempt to protect certain existing industrial gas loads and potential gas loads that are being placed in an unfavorable competitive position by gas service interruptions.

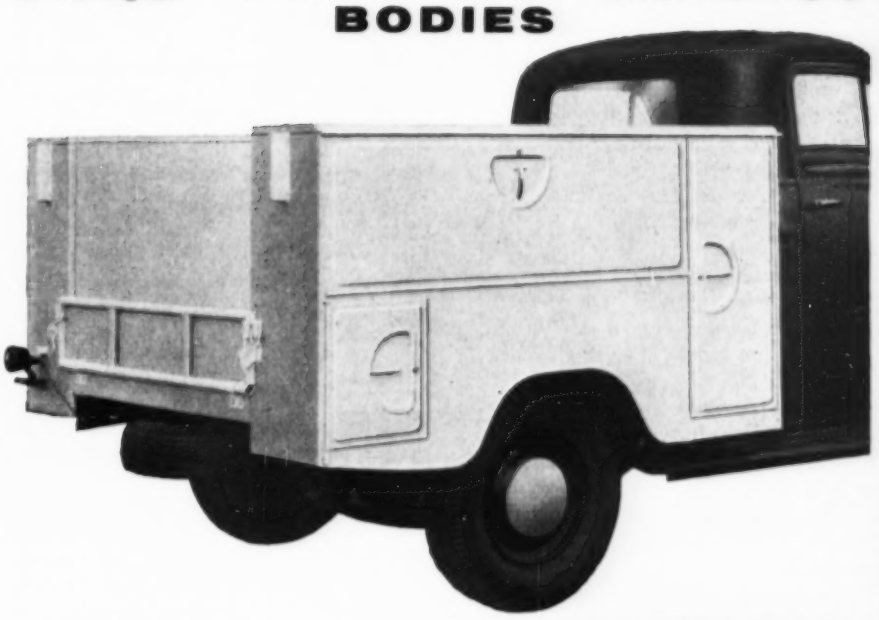
FIFTY YEARS ON TRACKS—This book, which tells the story of the track-type tractor, relates what led to the crawler's conception 50 years and the work it has done since then. The 104-page, hardbound book was written and published by Caterpillar Tractor Co.

Instead of a page-to-page unbroken story, the book is a series of separate, chronological essays. Perhaps the most unusual feature of the book is its photographs, most of which were selected from Caterpillar's photo files. Some of them are more than 60 years old.

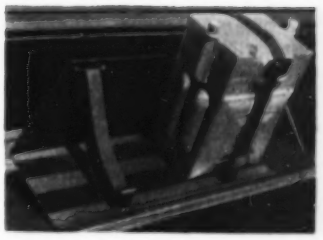
For additional information about the book, which sells for $1.25 per copy, write Caterpillar Tractor Co., San Leandro, Calif.

Completely NEW . . . for Gas Utilities

Meter Installation and General Service BODIES



● **Morrison's new gas utility Service Bodies and Accessories give your trucks a clean, neat appearance . . . provide maximum safety for crew and equipment . . . feature a compact design with more useable carrying space and a time-saving accessibility to tools, parts and supplies.**



With models to fit 40 different ½ - ¾ - 1 and 1½-ton, single or dual wheel chassis . . . 18 possible compartment arrangements . . . completely weatherproof compartments . . . and more than 20 other new design and construction features, Morrison Service Bodies are engineered and built to specific requirements of gas utilities, according to their recommended specifications.

Morrison Service Bodies and Accessories can completely equip any truck for any job. For meter installation and service there are Meter Trays for both horizontal and vertical compartments. They are equipped with necessary padding and hold-down straps which clamp the meter securely in place without sacrificing easy access for loading and unloading. Other available optional equipment includes material trays, pipe racks, forward pipe rest, rear mounted pipe vise bracket and rear bumper step.

In all phases of gas service work, Morrison Service Bodies and Accessories can help you promote crew efficiency and cut operating costs. Complete information on the entire line is available on request.

For Better Service and Greater Utility . . . Specify

Morrison service bodies

Morrison Service Body Division

MORRISON STEEL PRODUCTS, INC. • 696 Amherst St. • Buffalo 7, N. Y.

GAS associations——

SGA convention to attract 2000 to New Orleans

Two thousand delegates are expected to register for the 47th annual convention of the Southern Gas Association when it gets under way May 16-18 at the Roosevelt and Jung hotels in New Orleans.

Section meetings and subject matter will include: Accounting (Jung hotel): "Some Current Economic Symptoms," Robert W. Elsasser; "Should We Read Annually, Bill Monthly?" W. D. Sweetman, Peoples Gas Light & Coke Co.; "Getting Down to Basics in Utility Credit Policy," H. S. Hahn, Ohio Fuel Gas Co.; "Untraveled Avenues for Depreciation and Obsolescence," W. F. Loflin; "Significant Changes in the 1954 Revenue Code," David G. Wurreschke.

Accident prevention (Jung hotel)—"What a Safety Program Does For a Company," William Grant Jr., Humble Oil & Refining Co.; "Partners in Safety," W. G. Power, General Motors; "Human Factors in Safety," Dr. J. L. Rosenstein.

Distribution (Jung hotel)—"The ASA B-31, Section 8, Transmission and Distribution Piping Code," Fred A. Hough, Bechtel Corp. (a joint meeting with the transmission section); "Reduction of Unaccounted-For Gas in Distribution Systems," a symposium; "Experience with Use of Plastic Pipe," a panel discussion.

Transmission (Jung hotel)—"Is Oil Gas Competitive With Natural Gas?" A. D. Harrison, Brooklyn Union Gas Co.; "Natural Gas Transmission," an information panel.

Sales section (Roosevelt hotel)—"More Miles Per Dollar," H. Vinton Potter, AGA; "Servel's Plans for 1955," Duncan Cameron Menzies, Servel Inc.; "Progress in Gas Air-Conditioning," Sheldon Coleman, The Coleman Co.; "Salesmen—The Quick and the Dead," Howard D. Valentine, Peoples Gas Light & Coke Co.; "Built-In Cooking and Clothes Drying Units," a panel discussion. An industrial sales roundtable will also be held.

Employee relations (Roosevelt hotel)—"Do Your Greybeards Want Pre-Retirement Counseling?" Dwight S. Sargent, Consolidated Edison Co. of New York; "Human Factors in Employee Relations," Dr. J. L. Rosenstein; "What Is Worrying Company Presidents?" Guy Arthur Jr.; "Middle Management Must Learn to Manage," Dr. George D. Heaton.

Producers, utilities targets of blasts from NEGA speakers

Some highly critical estimates of the current position of the gas industry in the sales world were made for the edification of the 750 delegates who attended the New England Gas Association's 1955 annual business conference at the Hotel Statler in Boston March 24-25.

Time and again the attention of the delegates was drawn to various shortcomings in the job that is now being done. Virtually all the speakers, either directly or by implication, analyzed the situation as somewhat less than bright.

"The ten Test Cities have done a sales job—now 'go and do likewise,'" admonished T. T. Arden, GAMA president. Mr. Arden expressed his concern at the widespread lack of interest in the Gas Industry Development Program.

"How many of you have embraced this program? Frankly . . . in too many instances, this beautiful program has been buried in the files of utility after utility with little more than a passing thought. . . . A tremendously better job in appliance merchandising must be done if the interests of all of us in the industry are to be served."

While admitting that the appliance manufacturers had fallen down in many instances when called upon for local support of GID, Mr. Arden cited earnings data that proved that the *unregulated* gas appliance business is currently earning less than the *regulated* utility business. "Extra dollars for promotion, research, development, product improvement, etc. (have) just got to come out of earnings," he declared.

"The security of the New England gas industry in the next few years depends upon our ability to sell gas in heretofore unknown quantities," said President Roy E. Wright of NEGA Service Corp., Cambridge, Mass.

"Where else can we obtain the revenues to meet the ever-increasing costs of doing business in this inflationary era? Where else will many companies obtain the money to pay the demand charges on the gas contracted to buy in the next few years?"

Mr. Wright did not hesitate to lay the blame for the area's present predicament in the laps of the pipeline companies and producers. Said he:

"Many five-year forecasts were set up at a time when we anticipated a lower purchase price of natural gas, which would have made possible lower rates to the consumer. Today the purchase price of natural gas is higher than had been anticipated and our consumer rates have not been lowered to the point we at first thought they would go.

"In many places the gas rates are higher than competitive fuel prices. A market that could have been ours for the asking has been lost. The gas industry has missed an opportunity that will probably never come again in your lifetime or mine. The gas industry has missed the boat in New England, but I hasten to add that it was not the fault of the distributing local gas companies. They were just as helpless as the consumer public.

"The magic name of 'natural gas,' which our competitors had feared—to which our customers looked forward in anticipation—which was to be the vehicle through which we were to open up a vast new market—which was to be the salvation of the New England gas industry—has disappeared. Its value to the public has been lost. Our magic 'Cinderella' has vanished.

Participating in the NEGA operating panel discussion were, from left: Michael Anuskiewicz Jr., Brooklyn Union Gas Co.; Claude S. Hazel, Philadelphia Gas Works; Edgar C. Rhodes, New Britain Gas Light Co. (chairman); Charles E. Utermohle Jr., Consolidated Gas Electric Light & Power Co. of Baltimore; Edward F. Kennedy, New England Electric System Gas Division; and John L. Turnan, Worcester Gas Light Co.

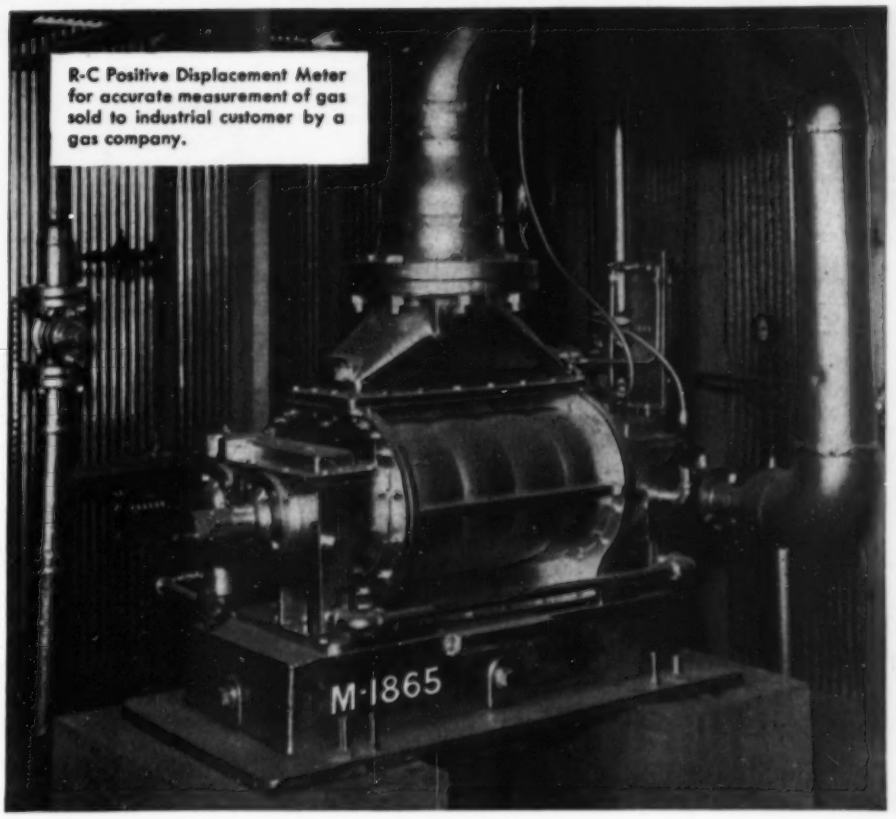
New officers of the New England Gas Association are (front row, l to r): Harold E. Ayer, Lynn Gas & Electric Co., incoming president; Roy E. Wright, NEGEA Service Corp., retiring president; Fred H. Faulstich, Springfield Gas Light Co., 1st vice president. Back row, l to r: Clark Belden, NEGA managing director; Edgar C. Rhodes, New Britain Gas Light Co., 2nd vice president; Otto Price, Boston Consolidated Gas Co., treasurer; and H. Coleman Moore Jr., NEGEA Service Corp., treasurer.

"If the producers and transmission companies want and expect the support of the gas industry, they had better start to think in terms of the gas industry and not alone in terms of their segment of the industry. Whether we, or they, like it or not, the facts are that our problems are their problems, and their problems are our problems. Cooperation is a two-way word. The facts are that any increase in the price of natural gas in New England resulting in increases in gas rates to the consumer would perilously affect our competitive fuel position. It might be the cause of losing a market that we have struggled valiantly to obtain at great expense. If this should happen, it not only would affect the financial stability of the distributing companies but would likewise affect the transmission and producing companies. It would force the distributing companies to turn to other sources of supply, as was recently so ably pointed out by our past president, Hall M. Henry, in his addresses before the managers conference and operating division.*

"(Now) the acceptance of gas and gas appliances has suffered. So we are faced with the greatest selling job in our history at a time when the acceptance of gas has been hurt and our competitive price position leaves something to be desired. Acceptance is everyone's job."

The call to unity among the segments of the industry—producers, pipeliners, distributors, and manufacturers—was extended into the realm of association activities by F. M. Banks, president of AGA (and Southern California Gas

*See GAS, March, page 50, and April, page 71.



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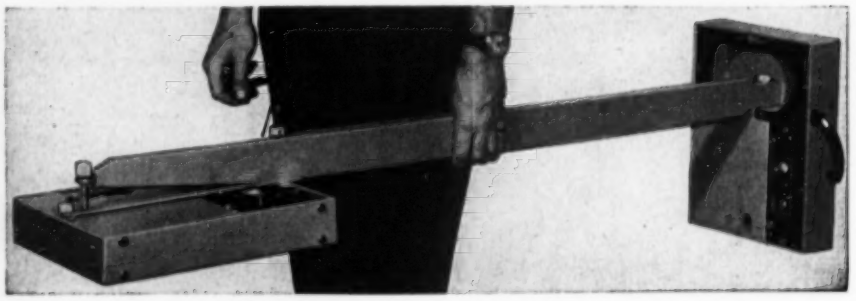

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Co.), and Clark Belden, managing director of the New England Gas Association, in their talks.

"It is my opinion," said Mr. Banks, "that strong regional activity by regional associations is a most effective means of getting things done, and I can tell you with certainty that the national association seeks only to discover means for working more closely with strong regional associations, as a matter of fact.

"I am sure there must be some members of the New England Gas Association, just as there have been members of other regional and state associations, who question from time to time the need for belonging to both a regional and a national trade organization. Basically, I believe, it has been the major purpose of AGA to carry on at the national level those activities that could not successfully be initiated at a local level. AGA also seeks to pursue for its member companies other activities and programs that those companies could not afford to carry on individually."

Mr. Belden effectively enunciated the viewpoint of the regional association.

"It appears very probable that 95% of the 1250 different persons attending our meetings do not attend any AGA meetings," he recited. "That is, we believe that about 1185 of the 1250 people rarely if ever attend any AGA meetings. One of the individual characteristics of the NEGA—in distinction to several other leading gas industry associations—is the very compact area in which we operate, with 94% of the area's meters located in our three southern and relatively small states. Because of the short distances involved, it has long been possible and feasible for our gas-utility members to send many more representatives to our various meetings than if the distances involved were several times as great. Indeed, NEGA is very much of a grass roots operation!

"In the Fuller, Smith & Ross survey for AGA, it is suggested that there is some luplication of activities among some of the gas-industry trade associations, it can safely be said that there is extremely little if any duplication between the activities of the NEGA and of the AGA. What are the facts? They are these: If the NEGA were to be abolished tomorrow, some 1185 representatives o fmember companies—mostly the gas utilities—would be left without any association meetings such as NEGA is conducting unless our gas utilities decided to send many of their rank-and-file employees to AGA meetings throughout the country at a much greater cost in time and money than is now required for attendance at NEGA meetings. Of course, there is the added

fact that the AGA—regardless of the distances involved—does not conduct meetings comparable in approach and in objective to some of those conducted by our divisions and groups."

Mr. Banks proposed to carry the theme of unity throughout the industry. He said:

"I believe the gas industry must close ranks and present a solid front against the increasingly savage onslaughts of our competitors. None of us, whether we serve those areas where natural gas has long been a bargain fuel or highly competitive areas at the end of the pipelines as New England now finds itself—none of us today can truthfully say: 'I am not faced with real competition.'

"Basic differences in opinion are bound to exist in different parts of the country—in Los Angeles and in Boston, for instance. I am not enough of an optimist to think we can resolve these differences simply by declaring: 'We Must Unite.'

"I believe there is—and must be—a mutual area of agreement larger than at present where most of these differences can be compromised. I believe a path of progress can be charted out of this area of agreement that each of us can follow without sacrificing principles or prestige.

"Distributing companies in New England may view the recent Supreme Court decision in the Phillips case somewhat differently than the producers in the Southwest. For it is just as vital to all parties concerned that the cost of natural gas up here at the end of the pipelines does not price this precious fuel out of the competitive market as it is that the further encroachment of federal authorities into privately managed business must be resisted.

"I believe that realistically priced natural gas can greatly aid the efforts of your energetic New England Council in rebuilding the industrial stature of New England. And as long as ample supplies of natural gas exist, I do not believe any gas utility company wants to revert to manufactured gas as an energy source, simply on a cost basis.

"For this reason the whole natural gas industry, and today that embraces about 90% of the entire industry, must work together as a team."

Diversified program given at management conference

Although management development constituted the major theme, it was by no means the only topic of discussion

(Continued on page 88)

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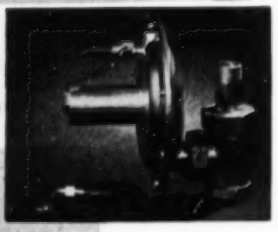

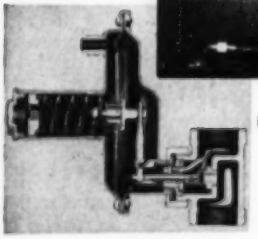

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GAS calendar

May

1-4 LPGA Annual Convention—Conrad Hilton Hotel, Chicago.

2-3 PCGA Transmission Conference — Palm Springs.

2-3 Gas Compressor Institute (University of Kansas & Southwest Kansas Petroleum Industry, co-sponsors) — Legion Hall, Liberal.

2-6 AGA Industrial Gas School—Hotel William Penn, Pittsburgh.

5-7 Florida-Georgia Gas Association Annual Management Conference — Key Biscayne Hotel, Miami.

9-10 AGA Gas Supply, Transmission & Storage Conference—William Penn Hotel, Pittsburgh

12-13 Public Utilities Advertising Association—Sheraton Hotel, Chicago.

16-18 Southern Gas Association — Roosevelt and Jung Hotels, New Orleans.

17-19 Pennsylvania Gas Association —Pocono Manor Inn, Pocono Manor, Pa.

18 PCGA Non-Residential Sales Clinic, Los Angeles.

19 PCGA Residential Sales Clinic, Los Angeles.

23-24 AGA Residential Gas Section New York - New Jersey Regional Gas Sales Conference — Hotel Commodore, New York.

23-24 AGA Chemical, Engineering & Manufactured Gas Production Conference — Hotel New Yorker, New York.

June

1-2 Tenth Annual Short Course in Gas Technology — Texas College of Arts & Industries, Kingsville, Texas.

5-9 Canadian Gas Association Annual Meeting—Sheraton-Brock Hotel, Niagara Falls, Ontario.

7-9 Mid-West Gas Association Gas School & Conference — Iowa State College, Ames.

9-10 Natural Gas & Petroleum Association of Canada — Royal Connaught Hotel, Hamilton, Ontario.

27-28 Michigan Gas Association—Grand Hotel, Macinac Island, Mich.

August

29-31..15th Annual Appalachian Gas Measurement Short Course—West Virginia University, Morgantown, W. Va.

September

9..New Jersey Gas Association —Hotel Monmouth, Spring Lake, N. J.

11-13..INGAA Annual Meeting — Jasper Lodge, Alberta.

27-30..International Gas Union 6th Conference — Hotel New Yorker, New York.

October

12-14..GAMA Annual Meeting — El Mirador Hotel, Palm Springs, Calif.

17-19..1955 AGA and PCGA Convention—Los Angeles.

November

14-17..American Petroleum Institute —San Francisco.

16-18..Southeastern Gas Association —Roanoke Hotel, Roanoke, Va.

28-30..SGA Advisory Council & Management Conference — Grand Hotel, Point Clear, Ala.

1956

March

19-21..MidWest Gas Association — Hotel Fontenelle, Omaha.

22-23..New England Gas Association Annual Meeting — Hotel Statler, Boston.

April

16-18..National Conference of Electric & Gas Utility Accountants — Hotels Biltmore and Commodore, New York City.

19-21..GAMA Annual Meeting — The Greenbrier, White Sulphur Springs, W. Va.

23-25..Southern Gas Association Annual Convention—Dallas.

May

7-10..AGA Distribution, Motor Vehicles, and Corrosion Conference—Congress Hotel, Chicago.

10-11..AGA Gas Supply, Transmission & Storage Conference—Conrad Hilton Hotel, Chicago.

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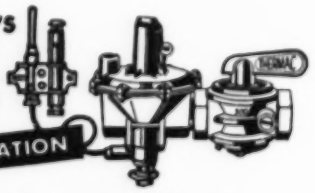

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associations • *Continued*

(from page 85)

at the spring conference of the general management section of the AGA when it convened in Cincinnati in March.

Rises in sales of both nondurable and durable goods for consumers were predicted by Dr. Charles F. Roos of the Economic Institute. This would include gains in gas-burning appliances.

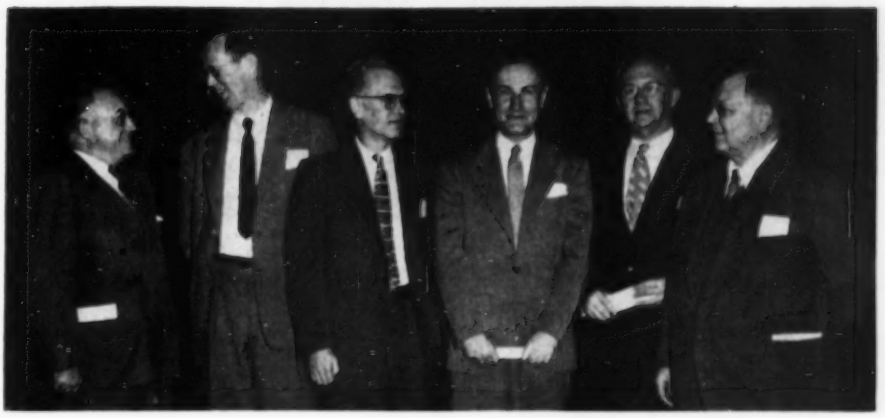
Dr. Paton, of the University of Michigan, speaking on the vital need for competition in our society, said a sure road to government monopoly would be to let competition degenerate.

At a luncheon session, F. M. Banks, AGA president, called the task of looking ahead to see what kind of managerial jobs will need to be filled an important approach to management development. Development of the ability in management people to appraise their subordinates is another important feature in any development program.

Homer A. Severne, vice president of John Hancock Life Insurance Co., pointed out that at the end of 1954, the life insurance industry had acquired about $14,600 million of securities of the total utility industry. This represented about 25.8% of all securities of the utility industry. He said that in 1954 the gas utilities raised $1138 million dollars of capital. Slightly more than $1 billion was in long-term debt and $63 million and $71 million in preferred and common stock, respectively. However, only $638 million of this was in new money, with $500 million in refunding and divestments. Gas utilities have increased plant by $7.75 billion or 154% since 1945, and have spent $9 million in construction.

Insurance companies played a major role in the great expansion of the industry, Mr. Severne said. If senior financing had not been available from insurance companies, some of the pipelines could not have been built. A great number of new pipelines could not have been financed in the traditional public utility way of a maximum of 60% debt and 40% preferred and common stock. But the insurance companies felt safe with contracts for assured supply at one end and contracts for assured customers at the other end of the lines. Today, the seven leading insurance companies hold about $2 billion invested in transmission and distribution securities.

At the final general sessions, Dr. Robben Flemming, University of Illinois, advocated collective bargaining as a method of settling labor disputes in public utilities. This method, he said, might be favored over the other alternatives, which he grouped as "compulsory arbitration," the "statutory strike," and "flexible legislation."



Talking over the new piping code at the distribution conference are from left: J. H. Collins Sr., New Orleans Public Service Inc.; F. G. Sandstrom, Consolidated Gas Co.; A. H. Cramer, Michigan Consolidated Gas Co.; George D. Mock, Washington Gas Light Co.; F. S. G. Williams, Taylor Forge & Pipe Works; and Dean M. Workman, Ebasco Services Inc.

Top panels highlight distribution conference

Discussions of routine problems overshadowed the more spectacular aspects as more than 1050 gas distribution men met at the AGA distribution, motor vehicle and corrosion conference held during the week of April 12-15 in Cincinnati. Not many of these recurring problems were finally solved, but the delegates were given the experience of outstanding panels and special papers from large and varied segments of distribution operation.

The influence and results of the newly approved ASA-B31.1 (1955) Piping Code on distribution operations were highlighted on the opening day and remained in the informal conversations throughout the conference. Greatest interest was shown in the effects of the code on distribution design, methods and equipment to prevent overpressuring in distribution systems and in operating and maintenance practices relative to gas distribution systems.

From the remarks of F. G. Sandstrom, F. S. G. Williams, Dean M. Workman, George D. Mock, and Carl E. Schmidt, it is obvious that distribution operators feel that the new code will have far-reaching effects on the operations of their systems in the future.

Featured during the convention were the luncheon conferences of the distribution design and development subcommittee, during which the remote control of regulator stations, remote control of underground gas storage projects, and telemetering were in the forefront.

John M. McCaleb of Columbia Gas System Service Corp. moderated an interesting panel concerned with the application of electronic devices to the engineering function of distribution system analysis. This panel carried network analysis from hand methods as produced by applying the mathematics sugested by Hardy Cross to this problem, through the final and efficient application of various types of network analyzers. This luncheon was attended by more than 150 delegates, which indicates the increasing interest in this modern method for developing distribution systems along lines of maximum efficiency.

The plastic pipe standards session, under the auspices of the subcommittee

Do you like it, dear? The beauty operator promised me THESE curls wouldn't pull out!

We don't recommend it as a hair style, but there is some merit to the lady's statement. That's why Standard Magnesium's VIBRA-PAK Anodes have a patented, *spiral* core. A core that just *won't* pull out.

There's just *one* of the many reasons for specifying VIBRA-PAK Anodes on your next corrosion job. There's also the fact that the magnesium used in each VIBRA-PAK Anode is *spectrographically analyzed,* to assure you of greater purity, more current per pound. And, of course, there's the time-saving factor which gives VIBRA-PAK it's name; each anode comes to you pre-packaged in backfill; compacted and centered, ready to drop in the hole.

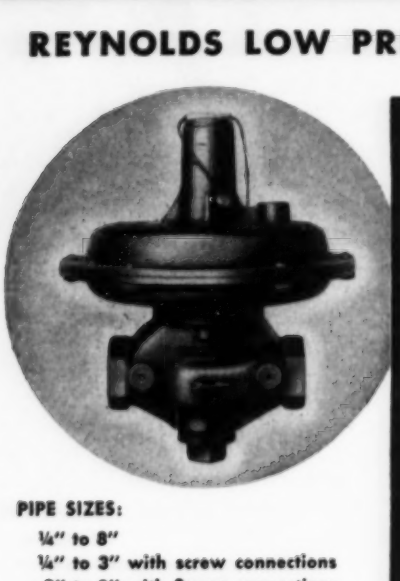
For longer life . . . more current . . . easier installation, specify VIBRA-PAK Magnesium Anodes on YOUR next job.

Standard Magnesium Corporation
TULSA, OKLAHOMA

Pioneers of: SPECTROGRAPHICALLY ANALYZED ANODES AND CYLINDRICAL ANODES

Steady

REYNOLDS LOW PRESSURE REGULATORS



PIPE SIZES:
¼" to 8"
¼" to 3" with screw connections
3" to 8" with flange connections

Reynolds Low Pressure Regulators guarantee steady, constant, unvarying outlet pressure even though the volume varies and inlet pressure fluctuates. Precision built and delicately balanced for accurate performance on low pressure installations, the units illustrated are backed by factory tests over a wide range of operating conditions. Reynolds Low Pressure Regulators are economical and safe. Our Engineering Department is at your service.

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GAS CONTROL SINCE 1892

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PIPE STOPPERS OF ALL KINDS

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associations • *Continued*

on plastic pipe standards, which was headed this year by John F. Fugazzi, was as usual of primary interest to many of the distribution system operators.

NEGA honors members for outstanding service

Two new recipients of the NEGA embossed fountain pen and pencil set, symbol of outstanding association and division service, have boosted the total number of members thus honored to 15. Herman Koester Jr., employee of a manufacturer company member, and W. C. Wolff who is employed by a distributor company member, received the awards at the recently held annual meeting of the NEGA in Boston. Both have been very active in affairs of the association.

Also awarded to members of the association were seven contest cash prizes ranging from $75 for first prize to $10 for honorable mention. The contest, first in 15 years, was under the title of "What NEGA Means to Me and Thus to My Company." Contestants wrote a letter stating how they and their companies had benefited, and prizes were awarded on the merits of the letters. Prizes were awarded to Charles V. McCaffery, Eugene J. Ivers, Lester Gurney III, W. Raymond Ahern, Lawton P. Bourn, Harry Eisenberg, and Herbert C. Jones.

Transmission conference to discuss new developments

New developments and advances made in natural gas production, transmission, processing and measurement will be discussed at the natural gas supply, transmission and storage conference sponsored by the operating section of the American Gas Association, May 9-10, at the William Penn hotel, Pittsburgh.

General sessions will be conducted both mornings, with luncheon sessions and round-table discussions in the afternoon. Five afternoon meetings are scheduled for Monday and four on Tuesday.

George W. McKinley, Hope Natural Gas Co., chairman of the transmission committee, will preside at the general session on Monday. J. H. Collins Sr. will report on the section's activities. Raymond W. Todd, Pacific Lighting Gas Supply Co., will talk on gas measurement for underground storage. C. J. Hauck, Ohio Fuel Gas Co., will discuss hydraulic fracturing.

New developments in detergents for cleaning pipelines will be reported by

Clinton McClure, El Paso Natural Gas Co. Arthur Kohn and Fred Riesenfeld, Fluor Corp., will describe advances made in conditioning natural gas for transmission. R. D. Ricketts, Fish Engineering Co., will complete the morning program with a paper on prime movers and gas compressors.

C. W. Studt, Union Gas System, chairman of the AGA committee on underground storage will be chairman at the general session on Tuesday. H. L. Fruechtenicht Jr., Michigan Gas Storage Co., will present the informative annual statistical report on underground storage of gas in the United States, compiled by the subcommittee on statistics, which he heads. A. Bruce Bowden, Mellon National Bank & Trust Co., Pittsburgh, will talk on the financial aspects of underground storage.

The importance of weather in relation to gas dispatching will be reviewed by Dr. Irving P. Krick, weather consultant from Denver. Microwave, as a medium of communication in the gas industry, will be discussed by C. E. Upson, Texas Illinois Natural Gas Pipeline Co. Clark F. Jones, National Fire Protection Assn., will talk on disaster control and action taken by gas companies to continue services in emergencies. Papers on research and corrosion will be delivered by J. L. Thompson, Michigan Wisconsin Pipe Line Co., head of the pipeline research committee, and J. W. Berringer, Panhandle Eastern Pipe Line Co., vice-chairman of the committee on underground corrosion mitigation.

The luncheons will start at 12:30 and continue through the afternoon. Monday meetings will cover measurement, production, communications, compressors, and pipelines. Tuesday afternoon meetings will be devoted to communications, storage, dispatching and the revised Code for Pressure Piping.

E. N. Armstrong, Transcontinental Gas Pipe Line Co., will preside at the measurement meeting on Monday. W. E. Ferguson, Ohio Fuel Gas Co., will head the group discussing natural gas production and S. A. Chadwell, Columbia Gas System Corp., will serve as chairman at the luncheon session where dispatching problems will be discussed.

In addition to presiding at the general session on Tuesday morning, C. W. Studt will serve as chairman at the afternoon session which also will be devoted to discussions on underground storage.

6-point public information program launched by AGA

Six basic areas of ignorance are the targets of an expanded public information program launched by American

Get all these advantages

with Parsons 150 Trenchliner

- **30 digging feeds from 12 inches up to 25 lineal feet per minute**
- **6 trench widths from 16 to 26 inches; depths to 5¾ feet**
- **multiple depth selections with hydraulic digging-wheel control**
- **quick-change buckets, solid-type or tine-back, with gumbo lips or "Tap-In" teeth**
- **retractable bucket-cleaner sabre-type, with optional solid cutter**
- **controlled discharge, with reversible, shiftable belt conveyor**
- **standard tractor crawlers, with 16-inch treads, lug-type shoes; street pads optional**
- **12-inch crawlers with flat shoes also available for city work**
- **choice of standard-make, 60 h.p. gas or diesel engine**
- **All main gears enclosed in constant oil bath; all main shafts mounted on antifriction bearings**

When your work schedules call for transmission lines between cities, or additional gas distribution and service lines in town, it will pay you to see what this Parsons 150 wheel-type Trenchliner can do for you. It meets a wide range of trench requirements — combines high-speed operation with exceptional grading accuracy.

Specified grades are easy to maintain. A hydraulic ram on vertical mast raises and lowers the digging wheel — gives fractional-inch depth adjustment, maintains close grade tolerance in toughest digging. Simple mast design eliminates unnecessary superstructure — gives low overhead clearance for work and travel. A separate hydraulic ram tilts the mast, balances weight of the wheel forward for traveling or trailer-loading.

Check the other 150 Trenchliner advantages listed here — then see Parsons distributor or write us. Larger wheel and ladder-type Trenchliners, and rubber tired Trenchmobile® also available.

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Send us bulletin on 150 wheel-type Trenchliner.

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COMPANY_____ DIV_____

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ONLY PEERLESS OFFERS MORE ATTRACTIVE FEATURES FOR GREATER SALES IN GAS HEATING

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Sell the whole PEERLESS line — reap the whole profit. A size and style for every need.

Peerless GAS CONSOLE HEATERS

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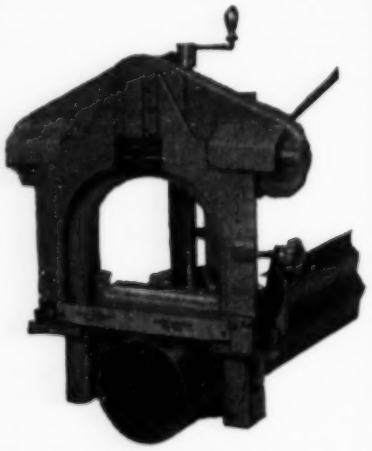

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WACHS GUILLOTINE SAW FACTS—

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- Cuts Square
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- Depth 12"
- Set up time, less than one minute
- Power—electric or air motor
- Weight 105 pounds

For further information write to:

THE E. H. WACHS COMPANY

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CORROSION PROBLEMS?

- Surveying
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- Installation
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Our specialized ability is available to help you solve all your cathodic protection problems.

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ANODE SPECIALISTS AN·SPEC

HIGH QUALITY ANODES

PIPE LINE Anode CORPORATION

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associations • *Continued*

Gas Association under the PAR plan.

According to Remick McDowell, chairman of the AGA general public information planning committee, the 1955 effort is a major step toward a long-range industry-wide information program. Some 68 gas, combination and and pipeline companies serving more than 8 million meters are already directly supporting the public information activities and additional companies are expected to sign up this year.

Highlight of the 1955 drive will be a series of down-to-earth regional workshops on public relations subjects. Top management, public relations staffs, supervisory and home service personnel will be invited to participate in discussions of specific regional and industry problems. Special efforts will be made to coordinate AGA activities with the information programs of other industry associations.

The objectives will be met through a broad variety of activities including institutional advertising, how-to-do-it booklets, exchange of ideas and company practices, news releases, feature articles and personal contacts.

Information targets to be attacked during 1955 are:

(1) Develop greater awareness among employees, stockholders and customers of their vital stake in the American private enterprise system.

(2) Stimulate greater public appreciation of gas—the ideal fuel.

(3) Inform employees on gas industry fundamentals and stimulate public relations action.

(4) Create better public understanding of the gas industry's economic and financial needs.

(5) Encourage investment of funds in gas industry securities.

(6) Acquaint school students with the modern role of gas and gas appliances (PAR Education Service Bureau).

Oklahoma Utilities meet attracts 500 visitors

The 37th annual convention of the Oklahoma Utilities Association was held March 24-25 at the Mayo hotel in Tulsa. More than 500 people were in attendance, including visitors from Oklahoma, Texas, Kansas, Missouri, and Michigan.

Speakers at the gas section were Tom P. Walker, president of Transcontinental Gas Pipe Line Corp., who spoke on "The Battle of the Btu's," and G. R. Walton, industrial sales engineer of the United Gas Pipe Line Co., who spoke on "Natural Gas—Chemical Giant."

GAS people

Promotions

JOHN E. OVERBECK has been elected vice president for engineering and research of the Columbia Gas System Service Corp. Mr. Overbeck, who succeeds the late Charles F. deMey, was formerly assistant vice president in the engineering department with headquarters in Columbus, Ohio.

A. D. MATARESE, vice president and general manager, has been elected president of Brockton Taunton Gas Co., Brockton, Mass., succeeding ISAAC S. HALL, who is retiring after 28 years with the company.

The Day & Night division of the Carrier Corp. has named CRAIG C. STIREWALT as northern California sales manager and LOUIS M. HULL as manager of new construction sales.

WILLIAM H. CURTISS JR. has been named general sales manager of the Pacific Coast division of Owens-Corning Fiberglas Corp. with headquarters in Santa Clara, Calif.

RICHARD S. MAXWELL has been promoted to Columbus district credit manager of the Ohio Fuel Gas Co.

CHARLES A. HEATH has been promoted to vice president and director of engineering and operations for Heath Survey Consultants Inc., Boston. The company also named STUART B. EYNON to the post of manager of operations for its leakage control surveys.

DONALD L. GARDNER has been elected assistant secretary of Laclede Gas Co., St. Louis.

WALTER A. MESSICK has been promoted to manager of manufacturing engineering at Servel Inc. The company has also appointed KENNETH V. OLSON as district sales manager for the Kansas City district.

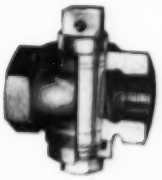
WILLIAM J. HARVEY has been named to succeed ROBERT H. PHILLIPS JR. as general manager of the gas department of Public Service Electric & Gas Co., Newark. JACK V. RICHARDS is his assistant and ERNEST F. WEEKS succeeds Harvey as general superintendent of gas manufacture.

JOE D. REID, formerly vice president and operating manager of West Ohio Gas Co., Lima, Ohio, has been elected president and general manager following the retirement of GEORGE S. VAIL.

"Better get a quote from ECLIPSE"

. . . FOR FAST SERVICE ON GAS COCKS

STANDARD—Eclipse iron body brass core construction serves better, longer. Individually tested at 125 lbs. and guaranteed as to gas-tightness, accuracy and alignment of tappings.



"RETAINED KEY" — Tamperproof construction . . . offers in addition the assurance that key will not be blown from or pulled out of the body even though the lock nut is removed or the tail piece snapped off.

Both types available for immediate, partial shipment, in flat head or lock wing style, black or galvanized finish.

. . . COMPLETE STOCKS OF RIGID METER BARS

STANDARD UNION, with standard type, gasket or ground joint union. Simplify and speed setting, give maximum protection to the meter. ALSO AVAILABLE WITH INSULATED UNION.

SLEEVE UNION, with threaded, one-piece sleeve union connections . . . no gasket required. Soundness and accuracy guaranteed.

COMPRESSION TYPE has threadless connection for "stab fit" of pipe. Gives maximum protection, plus new speed, flexibility and low cost meter settings.

All types available with or without integral gas cock (standard or "retained key") in wide range of sizes and styles.

ECLIPSE FUEL ENGINEERING CO., ROCKFORD, ILLINOIS

ECLIPSE FUEL ENGINEERING CO. OF CANADA, LTD., TORONTO, ONTARIO

GAS COCKS — Eclipse — METER BARS

Write today for new Eclipse Rigid Meter Bar Bulletin, P-1; Gas Cock Bulletin, P-12.

Eclipse Fuel Engineering Co., 1109 Buchanan St., Rockford, Illinois

( ) Please send new Meter Bar Bulletin P-1
( ) Please send Gas Cock Bulletin P-12
( ) Please send samples for inspection and test.

Firm Name _____
Individual _____
Address _____
City _____ State _____

people • *Continued*

WILLIAM J. MURRAY has transferred from the Syracuse, N. Y. office of Surface Combustion Corp. to take charge of the Ardmore (Philadelphia) office and WILLIAM M. DEMPSTER has moved from the Chicago office to manage the Syracuse office.

Be Completely Insured!

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the complete Gas Leak Location and Mitigation Survey Program

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M-SCOPE PIPE FINDER

"ELECTRONIC WITCH"

Especially Designed to Find Hard To Locate Gas Pipes

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LP Gas Installations and Anhydrous Ammonia Plants

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H. D. Borger
Peoples Natural

J. J. Jacob

H. DONALD BORGER, executive vice president of Peoples Natural Gas Co., Pittsburgh, has succeeded JOHN J. JACOB JR. as president of the company. He also succeeds him as director of Consolidated Natural Gas Co. Mr. Jacob, who is retiring, joined Peoples as a civil engineer in 1922 and since then has served as chief civil engineer, executive assistant to the president, vice president and assistant manager, executive vice president, and president since 1953.

With the retirement of PAUL STARK, vice president and treasurer, Indiana Gas & Water Co. has made the following changes: HERMAN G. HORSTMAN is now vice president in charge of district operations; LOUIS A. KIRCH, in addition to his duties as chief engineer, is now a vice president; and JOHN F. KAVANAGH, comptroller, has been named treasurer.

STUART E. MCMURRAY, treasurer, has been elected a director of Peoples Natural Gas Co., Pittsburgh.

NORMAN R. BRADLEY has been named industrial relations manager of the Consolidated Natural Gas System, with headquarters in Pittsburgh.

M. NIELSEN, vice president of Babcock & Wilcox Co., New York, has been elected executive vice president of the company and L. S. WILCOXSON, who has been vice president in charge of research, is now vice president in charge of the boiler division.

GEORGE A. CHAPPELL JR. has joined Cobell Industries Inc., Fort Worth, as chief engineer in conjunction with the expansion plans of the company.

FRED K. KRELL has joined the Ladish Co., Cudahy, Wis., as assistant sales manager of the fittings division.

F. M. BANKS, president and general manager of Southern California Gas Co., has been elected to the board of trustees of the California Institute of Technology.

F. L. BYROM, who has been manager of operations, Tar Products division of Koppers Co. Inc., has been promoted to a divisional vice presidency and assistant manager of that division.

J. ARTHUR JENKISSON has joined the Geo. D. Roper Corp., Rockford, Ill., as sales manager of the Special Appliance division.

GILBERT J. WILLIAMS, executive vice president of the Connecticut Light & Power Co., has been elected a director of the company, succeeding PAUL R. FLEMING, former vice president and treasurer, who has retired from the board.

Bucyrus-Erie Co., S. Milwaukee, has named EDWIN T. GOREE assistant sales manager, excavator distributors. JOHN H. PLEHN has rejoined the company as a sales representative in the Seattle office.

H. M. REEVES SR. has been elected vice president of Florence Stove Co., Chicago.

JACK A. BELANGER has been promoted to assistant sales manager for the commercial sales division of the Detroit-Michigan Stove Co.

J. H. BRINKER has been named general manager of the Permaglas division of the A. O. Smith Corp. and S. E. WOLKENHEIM, formerly general sales manager, succeeds Brinker in Milwaukee as director of marketing. R. J. SHEPHERD, who has been manager of water heater sales, fills the general sales manager post.

C. B. SCHMIDT, president of DeLaval Separator Co., has been elected a director of Central Hudson Gas & Electric Co., Poughkeepsie, N. Y.

CHARLES E. BEAVER, general sales manager, has been elected a vice president of Research-Cottrell Inc. and SCHAEFFER E. SPECHT is assistant sales manager.

Trasnfers

R. V. DAVIS, formerly with the A. O. Smith Corp. and the Southern California Gas Co., has joined Bufnel Co. Ltd., Los Angeles, as vice president in charge of sales, Steel Grating Products division.

ARTHUR B. ALLYNE has resigned as assistant general manager of Honolulu Gas Co. and is now affiliated with Fish

In the Liquefied Petroleum Gas Industry . . .

Your Market grows every Year!

The LPG industry has set a new, all-time sales record *every year for 32 straight years!* In the past 9 years, fuel sales have increased 302%*!*

Today the industry serves 8½ million consumers—in homes, on farms, in commerce and industry—and there are still 10 million more to be sold.

Here is an annual market for hundreds of thousands of kitchen ranges, automatic water heaters, space heaters and furnaces, refrigerators, clothes dryers and other domestic appliances . . .

. . . for huge quantities of cylinders, tanks, valves, piping and related equipment used in making LPG installations;

. . . for LPG carburetion, trucks and tractors, fork lifts and other power equipment, burners and torches, welding equipment;

. . . for *anything*, in fact, that operates on fuel or power.

Here is a market—not yet half grown in number of customers—which also presents limitless opportunities for additional sales to present customers.

To Sell this Market you need –

The Pre-eminent LPG Publication.

Every year for 16 straight years BUTANE-PROPANE News has carried more advertising than any other LPG publication... 32.7% more in 1954 than the second place magazine.

Write for market facts and for a copy of the new booklet "Who Can Buy Your Products in the LPG Industry"—an up-to-date report based on a 1954 survey of all 40,609 cities and towns listed in the U. S. Official Postal Guide for 1953.

BUTANE-PROPANE
Review and Forecast Issue
As an Advertiser you have a right to know
In the Liquefied Petroleum Gas Industry

NBP

A Jenkins Publication • 198 S. Alvarado St., Los Angeles 57, Calif.

COMING...next month

The first comprehensive report on one of the most daring and imaginative engineering ventures of the past decade will be a top feature of the June issue of GAS. This accomplishment, which is beginning to make available huge new quantities of gas to the ultimate consumer, is the prototype for other projects of a similar nature which will have a marked effect upon gas utility operations in the future.

Other "first-run" features in June GAS will include a study of valve operators for lubricated plug valves, a blueprinting of a system of radar profiling of microwave communication paths, and a scholarly discussion (with light touches) of meter adjustment principles and practices.

Plus staff reports from the major spring conferences and a selection of the best papers, with staff reviews of others . . .

. . . all in June GAS.

A. B. Allyne
Fish Northwest

P. E. Gray
Sinclair Oil

Northwest Constructors Inc., Houston, as an assistant to R. D. Ricketts, president. Fish Northwest Constructors will design and build the Pacific Northwest Pipeline Corp.'s system.

New faces

P. E. GRAY has joined Sinclair Oil & Gas Co. as sales engineer. He will headquarter in Tulsa.

WILLIAM L. DAVIES has joined Gar Wood Industries Inc. as assistant to Vie President Walter C. Robertson. He will headquarter in Washington, D. C.

RAY T. SHUTTLEWORTH has joined the Northern Indiana Fuel & Light Co., Auburn, Ind., where he will supervise sales and promotion.

SAMUEL S. ERICSSON has joined the Portland (Ore.) Gas & Coke Co. as assistant to the president. He was formerly with the U. S. Chamber of Commerce.

Deaths

WILLIAM M. MINYARD, 59 superintendent of transportation for Southern Counties Gas Co., Los Angeles, died late in March.

EDMOND L. SWEENEY, superintendent of the Everett plant of Boston Consolidated Gas Co. died recently. He had been with Boston Consolidated for 43 years.

HUDSON W. REED, former president of the Philadelphia (Pa.) Gas Works, died recently. Mr. Reed headed up the gas company from July 1942 until December 1953. Then he served as vice president and director of the United Gas Improvement Co. He retired in January 1954.

CHARLES J. GREGG, 71, retired Appalachian district sales manager of Dresser Manufacturing Division, died recently at his home in Bradford, Pa. He had been with the company 43 years prior to his retirement in 1948.

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CONVENIENT MOTOR LOBBY

- 800 superb guest rooms and baths
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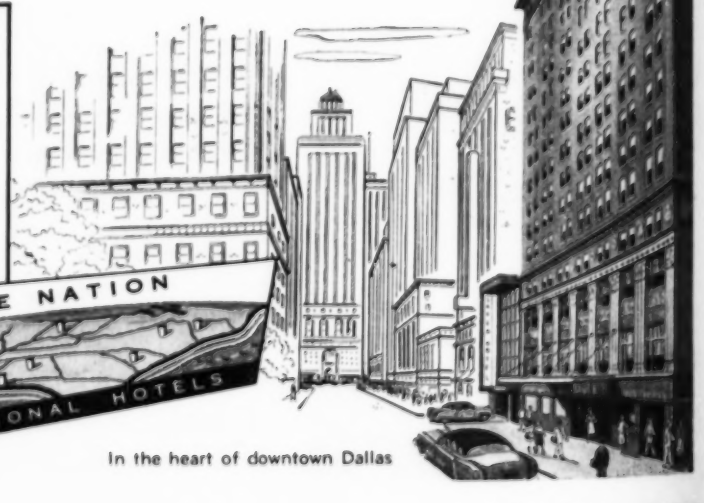
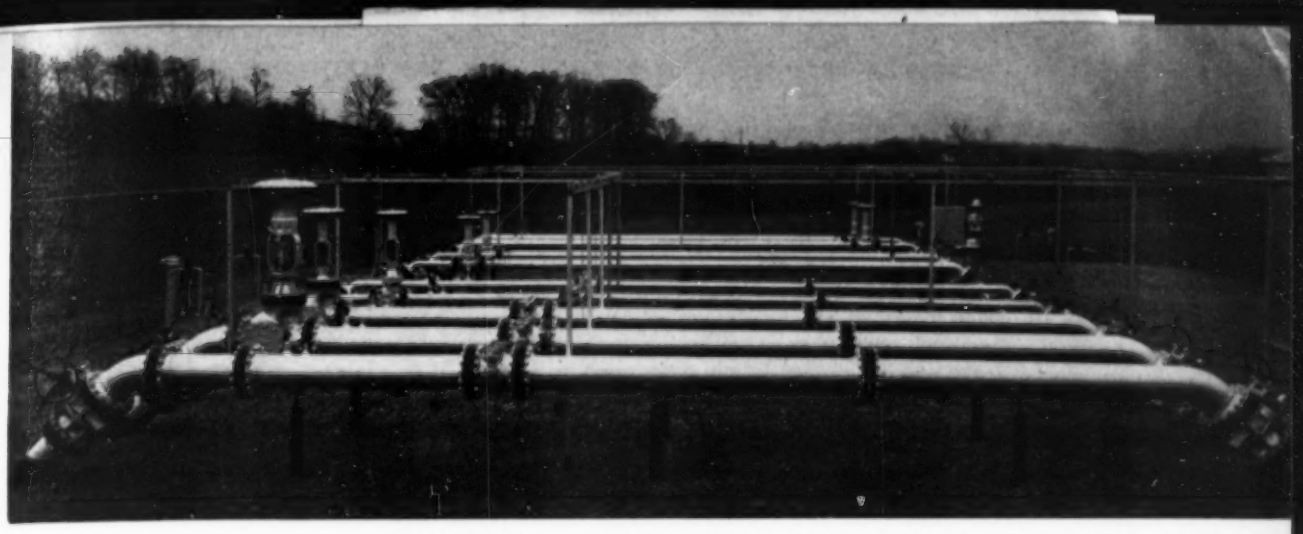
- Television or radios in guest rooms
- Circulating ice water and Servidors



In the heart of downtown Dallas



This installation at East Tennessee Natural Gas Co.'s Knoxville station shows the use of several parallel orifice meter runs. Pressure-reducing stations are in the rear. This represents one of four different types of installations for measurement of gas volumes for large-volume purchasers. The type of metering equipment to be installed depends on the particular metering requirements to be met, as described in this article.

GAS exclusive

Design of gas meter station flow measuring facilities

By ROBERT W. TIRRELL and JOHN P. EVERS
Ebasco Services Inc., New York

THE measurement of the volume of gas delivered to large-volume purchasers such as to secondary transmission systems, cities (via city gate stations), power plants, and large industrial plants, is usually accomplished by using one of the following installations:

1. Positive displacement meters of large capacity, operating singly or in multiple (two or more in parallel).

2. Differential-type orifice flow meters with simplex flow recorders, with or without automatic trip-over devices. By "simplex flow recorder" is meant a single range flow recorder. (Meters employing simplex flow recorders are herein referred to as "simplex orifice meters.")

3. Differential-type orifice flow meters with duplex flow recorder in one orifice run, or in the first of several orifice runs with trip-over devices (using simplex flow recorders in the balance of the orifice runs). By "duplex flow recorder" is meant a dual-range flow recorder, which usually consists of two single-range recorders acting together, one for low range operation, and one for high range operation. (Meters employing duplex flow recorders are herein referred to as "duplex orifice meters.")

4. Positive displacement meters replacing the differential-type orifice flow meter in the first run of a multiple orifice run installation, with trip-over devices.

The type of metering equipment to be installed depends upon requirements to be met, particularly the requirements concerning maximum and minimum flow.

Positive displacement meters are used singly or in parallel:

1. Where minimum volume flows approach zero.

2. Where maximum volume flows are comparatively small.

Simplex differential-type orifice flow meters are used singly or in parallel:

1. Where minimum volume flows to be measured are not too critical.

2. Where maximum volume flows are comparatively large.

Duplex differential-type orifice flow meters are used either alone or in parallel with simplex-type meters:

1. Where minimum volume flows to be measured are more critical than can be handled on a simplex meter.

2. Where maximum volume flows are comparatively large.

Positive displacement meters are used in parallel with simplex differential-type meters:

1. Where minimum volume flows approach zero.

2. Where maximum flows are comparatively large.

A 100-in. simplex flow recorder is accurate over a range from approximately 6 in. to 96 in., and has a flow ratio of approximately 4 to 1.

A 20-in. and a 100-in. flow recorder used in a duplex setting have a range from approximately 2 in. to 96 in. and a flow ratio of approximately 7 to 1.

A 10-in. and a 100-in. flow recorder used in a duplex setting have a range from approximately 1 in. to 96 in. or a flow ratio of approximately 10 to 1.

These flow ratios will apply only to the first run in a multiple meter run installation inasmuch as allowances for proper operation of trip-over devices result in lower flow ratios for the succeeding runs.

A positive displacement meter has a flow range from zero to the full capacity of the meter. For purposes of comparison with an orifice flow meter, the positive displacement meter can be considered as a meter having a range from zero to 96 in., and an infinite flow ratio.

For each particular installation the engineer must select the most economical and efficient measurement equipment for the service intended. This involves the determination of minimum and maximum flows to be measured, the study of growth requirements, op-

Mr. Tirrell (left) is mechanical project engineer for Ebasco. Mr. Evers (right), also a mechanical engineer, is his assistant.

erating pressures, and other pertinent facts.

Orifice flow meters

The basic formula for measurement of gas flow by an orifice meter is:

$$Q_b = C' \sqrt{h_w P_f} \qquad (1)$$

where:

Q_b = volume rate of flow at base conditions, in cubic feet per hour

C' = orifice flow constant

h_w = orifice pressure differential, in inches of water

P_f = absolute static pressure, in psia

In the above equation

$$C' = F_b \times F_r \times Y \times F_{pb} \times F_{tb} \times F_{tf} \times F_g \times F_{pv} \times F_m \qquad (2)$$

where:

F_b = basic orifice flow factor

F_r = Reynold's number factor

Y = expansion factor

F_{pb} = pressure base factor

F_{tb} = temperature base factor

F_{tf} = flowing temperature factor

F_g = specific gravity factor

F_{pv} = supercompressibility factor

F_m = manometer factor*

For purposes of *preliminary* design the factors F_r, Y, F_{pv} and F_m can be neglected, and the remaining factors F_{pb}, F_{tb}, F_{tf} and F_g become constants for the particular design conditions.

Letting

$$C'' = F_{pb} \times F_{tb} \times F_{tf} \times F_g \qquad (3)$$

the flow formula *for preliminary design purposes only*, because

$$Q_h = F_b \times C'' \sqrt{h_w P_f} \qquad (4)$$

In design, where several meter runs are to be operated in parallel, the total maximum flow can be represented by the formula

$$Q_H = F_B \times C'' \sqrt{h_w P_f} \qquad (5)$$

where: $F_B = F_{b_1} + F_{b_2} + F_{b_3}$ etc.

and F_{b_1}, F_{b_2}, and F_{b_3} represent the basic orifice factors of each individual run in the multiple installation.

In meter station design, it is common practice to use orifice plates with standard bores which vary in multiples of ⅛ in. and ¼ in. according to size of meter run involved. Since the basic orifice factor is established by these standard orifices, it is advisable to provide leeway in design calculations so that the final design will handle the total flow requirements. Therefore, in preliminary design calculations it is recommended that the maximum flow requirements be increased 10%, and equation (5) can be revised and rewritten as follows:

$$C'' = \frac{1.1 \quad Q_H}{F_B \sqrt{h_w P_f}} \qquad (6)$$

While it might be felt that the 10% increase in the maximum flow requirements will result in a larger installation than necessary, the practice of selecting orifices having a basic orifice factor equal to or slightly less than the required basic orifice factor (which has been calculated) results in a system having a capacity close to the specified requirements.

*As will appear in AGA Gas Measurement Committee Report No. 3.

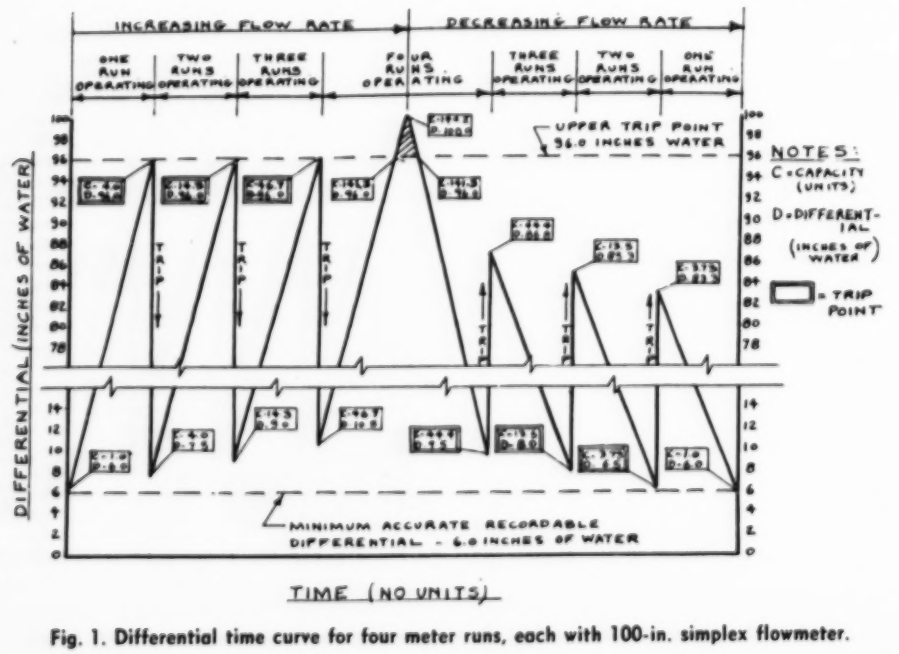


Fig. 1. Differential time curve for four meter runs, each with 100-in. simplex flowmeter.

When several meter runs are operated in parallel, it is common practice for the installation to be provided with a mechanical means of increasing or decreasing the number of meter runs in service. This is done in order to adapt the installation to varying flow requirements. Thus, as the flow is increased from minimum to maximum, one or more meter runs will be successively added to the initial run. Likewise, as the flow rate decreases from maximum to minimum these additional runs are cut out of service until only the initial run remains in operation. The adding or subtracting of each successive meter run is performed by a trip valve which operates automatically to add or subtract a meter run at present maximum and minimum flow ratio. In order to provide proper sequence of operation, these maximum and minimum flows must be established for each individual meter run, for it is essential that the trip points selected permit *only* the designated meter run to operate.

In developing work sheets for the design of a multiple-run 100-in. simplex orifice meter installation, the following assumptions may be made:

(1) The minimum accurate recordable flow differential for a 100-in. simplex flow meter is 6 in. of water.

(2) The upper trip point in *all* meter runs in a multiple run installation is to be set at a differential of 96 in.

(3) The lower trip point in a multiple run installation is to be set at a differential of 6.5 in. in Run No. 1, 8.0 in. in Run No. 2, and 9.5 in. in Run No. 3.

(4) A flow causing a differential of 96 in. in one meter run will cause a differential of 7.5 in. in two parallel runs; a flow causing a differential of 96 in. in two parallel meter runs will cause a differential of 9.0 in. in three parallel meter runs; and a flow causing a differential of 96 in. in three parallel meter runs will cause a differential of 10.5 in. in four parallel meter runs, etc.

(5) The ratio of maximum to minimum flow in each meter run is the square root of the maximum differential (90 in.) divided by the square root of the minimum differential (as described in 4 above).

Assigning a value of 1.0 (unity) to the minimum flow for a single 100-in. simplex meter run (6.0 in. differential), and utilizing the previously stated assumptions, capacity calculations have been made for installations having multiple runs with trip-over valves as shown

GAS FLOW METER CALCULATION WORK SHEETS — The example: Determine basic design of gas metering facilities suitable for the following conditions: (a) maximum flow, 300,000 scfh; (b) minimum flow, 3000 scfh; (c) specific gravity, 0.60; (d) flowing pressure, 100 psig; (e) flowing temperature, 60° F; (f) contract pressure base, 14.9 psia; (g) contract temperature base, 60° F.

CALCULATED BY C B C — GAS FLOW METER
DATE 12/15/54 — CALCULATIONS
CHECKED BY G W C. — WORK SHEET NO 1 OF 4

I DESIGN CONDITIONS:

Maximum quantity of gas to be metered (q_h)	300,000	SCFH
Minimum quantity of gas to be metered (q_m)	3,000	SCFH
Specific gravity of gas, relative to air (SG)	0.60	
Flowing pressure (P)	100	PSIG
Flowing temperature (T)	60	°F
Pressure base (contract)	14.9	PSIA
Temperature base (contract)	60	°F

II TOTAL BASIC ORIFICE FLOW FACTOR (F_b) CALCULATIONS:

Determine total basic orifice factor as follows:

$$*F_b = \frac{1.1\, q_h}{C' \sqrt{h_w P_f}}$$

F_b = total basic orifice flow factor = $F_{b_1} + F_{b_2} + F_{b_3}$ etc.

(F_{b_1}, F_{b_2}, etc. are basic orifice coefficients for individual meter runs)

q_h = maximum quantity of gas to be metered (from design conditions)

F_{pb} = pressure base factor (14.73PSIA ÷ 1)**	0.3886	
F_{tb} = temperature base factor (60°F ÷ 1)	1.0	
F_{tf} = flowing temperature factor (60°F ÷ 1)	1.0	
F_g = specific gravity factor (SG 0.60 = 1.291)	1.291	
$C' = F_{pb} \times F_{tb} \times F_{tf} \times F_g$ (for preliminary calculations)	1.276	

h_w = 96 in., maximum

P_f = P × 1½ = 115

$h_w P_f$ = 11,100

$\sqrt{h_w P_f}$ = 105

$$F_b = \frac{1.1\, q_h}{C' \sqrt{h_w P_f}} = \frac{1.1 \times (300{,}000)}{(1.276) \times (105)} = 2465.0$$

* F_b increased 10% for flexibility of design
** As will appear in AGA Gas Measurement Committee Report No. 3

CALCULATED BY C B C — GAS FLOW METER
DATE 12/15/54 — CALCULATIONS
CHECKED BY G W C — WORK SHEET 2 OF 4

III SELECTION OF METERING SYSTEM

1) Calculate the maximum flow ratio for the proposed installation as follows:

Maximum Flow Ratio = Maximum quantity of gas to be metered ÷ Minimum quantity of gas to be metered

$$= \frac{q_h}{q_m} = \frac{300{,}000}{3{,}000} = 100$$

2) For the above calculated flow ratio, select the total minimum number of meter runs required for each of the three types of installations listed on Table No. 1 and complete the following:

	Type of Installation	Simplex	Duplex Type A	Duplex Type B
	Calculated Maximum Flow Ratio	←	100	→
	Tabulated Maximum Flow Ratio**	141.3	247.3	116.6
Meter Runs	Total - Minimum No. of Runs Req'd**	4	4	3
	Less - No. of Duplex Runs	0	1	1
	Equals - No. of Simplex Runs Req'd	4	3	2

**From Table 1.

3) If a positive displacement meter is required in the first run of a multiple run installation, the following tabulation should be used to determine the number of meter runs and size of meter required. Columns 1, 2 and 3 of the table should be successively calculated to determine the capacity (at flow conditions) of a standard size positive displacement meter for installation in the first run.

CALCULATED BY C B C — GAS FLOW METER
DATE 12/15/54 — CALCULATIONS
CHECKED BY G W C — WORK SHEET 3 OF 4

Column Number	1	2	3
Type of Installation	1 P D Run 1 Simplex Run	1 P D Run 2 Simplex Runs	1 P D Run 3 Simplex Runs
Equation For Required Capacity in P D Meter	* 4x Max. Flow 14.3	* 4x Max. Flow 46.7	* 4x Max. Flow 141.3
Required Capacity, SCFH	83,800	25,700	
Manufacturer	Size not manufactured	Blank Meter Co.	
Model No.		IV	
Rated Capacity at Flow Conditions		28,000 SCFH	

4) After considering economy, provision for future expansion, and general conditions affecting the installation, select from the preceding tables the metering system to be used. List below the system selected.

Number of runs 3

Meter(s) for initial (check) meter run (one):
- ☐ Simplex (100*)
- ☐ Duplex Type A (20* and 100*)
- ☐ Duplex Type B (10* and 100*)
- ☐ Positive displacement

Basis of selection: Installation costs will be kept to a minimum if either a positive displacement meter or a Duplex Type B meter is used in the first meter run.

CALCULATED BY C B C — GAS FLOW METER
DATE 12/15/54 — CALCULATIONS
CHECKED BY G W C — WORK SHEET NO 4 OF 4

IV CONSTRUCTION DESIGN:

Complete design on chart using data given on Table 1, and preceding calculations.

Meter Run		1	2	3	4
Total Orifice Factor F_b (from Sheet No. 1)		← 2465.0 →			
K Factor (from Table No. 1)		0.085	0.221	0.694	
Fb (theoretical = F_b × K Factor)		209.5	545.0	1710.0	
Type of Taps (Flange or pipe)		FT	FT	FT	
Fb actual - selected from handbook		210.22	562.58	1746.7	
ID of Meter Run, Inches		2.067	3.068	4.026	
Orifice Bore, Inches		1.00	1.625	2.750	
Beta Ratio		.484	.530	.685	
Individual Run	Minimum Flow, SCFH	2,560	17,800	61,600	
	Low Trip Point, Inches	6.5	8.0	—	
	Maximum Flow, SCFH	25,600	68,500	213,000	
	High Trip Point, Inches	96.0	96.0		
Cumulative	Minimum Flow SCFH	2,560	24,200	88,800	
	Maximum Flow, SCFH	25,600	94,100	307,100	

V DESIGN COMMENTS: If a large future growth is probable with a corresponding increase in the minimum flow requirements, a 6.025 inch ID meter run with 2.975 inch orifice bore (Beta Ratio 0.477) should be used in Run No 3 in place of the 4.026 ID run shown above.

in *Table 1* on the following page.

An illustration of how the differential varies with a change in flow rate can be seen in *Fig. 1*, the "Differential-Time Curve" for a four-run, 100-in. simplex flow meter installation.

The maximum flow in each individual run can be readily determined by subtracting from the total capacity of

TABLE 1. Capacity calculation for multiple-run installations with trip-over valves.

Type of Installation	Differential (Inches of Water)	* Flow Capacity (Units)	Calculation
One Run Only	6.0	1.0	
	96.0	4.0	$\sqrt{\frac{96.0}{6.0}} \times 1.0 = 4.0$
Two Runs in Parallel	7.5	4.0	Same flow as above divided to two runs.
	96.0	14.3	$\sqrt{\frac{96.0}{7.5}} \times 4.0 = 14.3$
Three Runs in Parallel	9.0	14.3	Same flow as above divided into three runs.
	96.0	46.7	$\sqrt{\frac{96.0}{9.0}} \times 14.3 = 46.7$
Four Runs in Parallel	10.5	46.7	Same flow as above divided into four runs.
	96.0	141.3	$\sqrt{\frac{96.0}{10.5}} \times 46.7 = 141.3$

*Since the minimum flow of the first run was taken as unity, the maximum flow capacity calculated for a multiple run installation is also the maximum flow ratio for such an installation.

TABLE 2. Determining the maximum flow in each individual run.

Run No.	Total Capacity All Runs	Total Capacity All Runs Except Last Run	Capacity Of Last Run
4	141.3	46.7	94.6
3	46.7	14.3	32.4
2	14.3	4.0	10.3
1	4.0	-	4.0

TABLE 3. Maximum flow ratios and trip points.

Maximum Flow Ratio			Number of Meter Runs	Trip Point (Inches Water)		K Value Meter Run			
Simplex	Duplex Type A	Duplex Type B		Minimum	Maximum	1	2	3	4
4.0									
	7.0		1	6.5	96.0	1.000	-	-	-
		10.0							
14.3									
	25.0		2	8.0	96.0	0.280	0.720	-	-
		35.8							
46.7									
	81.8		3	9.5	96.0	0.085	0.221	0.694	-
		116.6							
141.3									
	247.3		4	-	-	0.028	0.073	0.229	0.670
		353.3							

NOTE:

The systems listed above as "Simplex" have 100 inch differential type flowmeters in all runs.

The systems listed as "Duplex-Type A" have 20 inch and 100 inch meters in the first run, and 100 inch meters in all additional meter runs.

The system listed as "Duplex-Type B" have 10 inch and 100 inch meters in the first run, and 100 inch meters in all additional meter runs.

Maximum flow ratios are based on constant meter run pressures at both high and low flow rates. If meter run pressure is not controlled, these factors must be changed by ratio of square roots of absolute pressures at low and high flow conditions.

the multiple installation, the 96-in. flow capacity unit values of all the runs except the last (see *Table 2*).

The maximum flow ratios and trip points calculated by the above method, are listed in *Table 3*. This table shows flow ratio data and trip point data for both "simplex" and "duplex" orifice flow meter installations having a maximum of four parallel runs with a maximum total basic orifice factors (F_b) of approximately 40,000. *Table 3* also shows "K values" for each type of installation. These K values are constants, which, when multiplied by the maximum flow for which the entire installation is to be designed, give the maximum flow requirements for each individual run to be used in the installation. In design calculations, the K values are used as multipliers of the total basic orifice flow factor for the entire installation (F_b) to obtain the basic orifice flow factor of each individual run (F_{b_1}, F_{b_2}, etc.).

Calculations and procedures discussed in the preceding paragraphs cover simplex meter installations only. However, the development of capacities and ratios for installations having a duplex meter in the first run is basically the same as for installations having a simplex meter in the first run. *Table 3* shows design data for both simplex and duplex installations.

Positive displacement meters

The design of installations that use positive displacement meters *only*, operating singly or in parallel, presents no unusual problems. However, when a positive displacement meter is used in the first run of a multiple-run installation employing differential type meters, it has been found desirable to establish a definite procedure for the design of the installation. The recommended procedure is given in Section III, Part 3 of the work sheets, and covers the determination of an economical installation having its first run capacity within the limits of an available standard size positive displacement meter.

Work sheets (see page 127)

The work sheets have been developed on the basis of theories previously expressed. They make no attempt to explain each step of the calculation, it being expected that engineers using these work sheets will be familiar with basic flow meter system requirements and calculations, and that necessary data books will be available for their use. ■

1955

$811 million budgeted for pipeline building despite TransCanada postponement

IF financing difficulties had not bogged down construction of the TransCanada pipeline project, it is possible that 1955 transmission projects alone would have exceeded a billion dollars . . . and would have resulted in the largest construction year in the history of the gas industry.

Even without the huge TransCanada project, the transmission budgets of 63 major transmission and integrated companies participating in GAS magazine's "Annual Survey of Gas Industry Construction Projects" totaled $811.7 million—proof that gas transmission is still expanding.

Of the $811.7 million, $561.8 million was unsegregated, which means it was not broken down into pipelines, compressor stations, etc.: $172.5 million was definitely labeled for new pipeline; $15 million for replacement of line; $49.5 million for compressor stations and auxiliary equipment; and the remaining amount for autos, trucks, construction and miscellaneous equipment. (Charts on pages 38 and 39 of this issue of GAS show yearly comparisons of construction budgets, and breakdown by types of projects and types of companies.)

On the following pages are the 1955 editions of GAS magazine's annual pipeline progress maps. The first map covers transmission lines approved or under construction; the second covers lines planned or proposed.

• • •

The most ambitious pipeline transmission project to be considered in several years was tabled for at least another year when TransCanada Pipe Line Ltd. encountered financing difficulties in carrying out its plan for a line to extend from the vast southern Alberta gas fields, across the prairie provinces of Saskatchewan and Manitoba, across Canada's granite Laurentian shield, around the northern shore of Lake Superior and on to the industrial centers of eastern Canada.

Canadian gas fared better in the Pacific Northwest. Arrangements have been finalized to make natural gas from the Peace River gas fields in British Columbia and Alberta available to United States markets. Three major pipeline companies are involved in transactions, which will result in a giant network of pipelines linking the gas resources of United States and Canada.

Westcoast Transmission Co. Ltd., which controls large reserves of natural gas in the Peace River district, will sell 300 MMcf of gas daily to Pacific Northwest Pipeline Corp. at a reported price of 22 cents per Mcf at the U. S. border. This will involve the construction of a 650-mile, 30-in. line from northern Canada to the U. S. border near Sumas, Wash., at a cost of $120 million. Of the 300 MMcf, Pacific will deliver 250 MMcf per day to El Paso Natural Gas Co. at a point near Mountain Home, Idaho, for transmission to Reno and eventually California. The 370-mile line to Reno will be built at a cost of $35 million.

The remaining 50 MMcf, and more when developed, will be used by Pacific Northwest to supplement its primary supply from the San Juan basin of New Mexico. Together these two sources will be utilized in the expansion of Pacific Northwest's markets, which include Seattle, Tacoma, Portland and Spokane. The company will spend $160 million for facilities to bring gas from the San Juan basin, to the industrial centers of the Northwest. It has been reported that this line will be completed 18 months prior to the first delivery of Canadian gas.

FPC has already certified a fourth link in the network. Colorado Interstate will build 365 miles of 22-in. line to carry 110 MMcf per day from a point on Pacific Northwest's line at Rock Springs, Wyo., to its market area near Denver. Colorado Interstate connects with lines taking gas to Chicago. Consequently, Canadian gas will have access to virtually all U. S. markets.

The combined projects involve the construction of 3000 miles of pipelines at an estimated cost of $350 million.

• • •

The third transmission project to cost more than $100 million scheduled to start this year will be a 1289-mile line to extend from gas fields west of New Orleans to Detroit. Gas from this $130 million pipeline will be purchased by Michigan Consolidated Gas Co. and Michigan-Wisconsin Pipeline Co. Each of these companies will have to enlarge their facilities to handle the additional gas supplies.

The mainline will be 30 in. in diameter and will be powered by three compressors with a total of 30,000 hp. The line will have an initial capacity of 300 MMcf of gas per day.

American Louisiana said its new line will result in the removal of all restrictions now in effect on the sale of gas for heating and other purposes by all utility customers served by Michigan-Wisconsin.

TURN PAGE FOR PIPELINE PROGRESS MAPS →

GAS survey

Pipeline Progress maps show where gas transmission dollars will be spent

1. Alabama-Tennessee Natural Gas Co., Florence, Ala.

A 21.2-mile line from the end of its present 12-in. line south of Florence, to the Mississippi state border. Project will increase capacity of existing system. Cost: $600,000.

2. Alberta Gas Trunkline Co. Ltd., Alberta.

A 130-mile gathering line near Edmonton-Bonnie Glen line south to Calgary; 80-mile line to Bassano, and 130-mile line to Saskatchewan boundary to gather and move gas to meet Alberta's requirements and export needs.

3. American Louisiana Pipe Line Co., Detroit.

A 1200-mile, 30-in. line from North Tepetate, Arcadia parish, La., to a point of connection with Michigan Consolidated Gas Co.'s facilities near Detroit. A 22-in. lateral will take off from the mainline at a point near Payne, Ohio, and will extend to a connection with Michigan-Wisconsin Pipe Line Co.'s system near Bridgeman, Mich. A 24-in. and smaller size line will feed gas into the 30-in. line at North Tepetate. Total cost of $130 million includes three compressor stations with 10,000 hp each. All gas transported by the new line will be purchased by Michigan-Wisconsin Pipe Line Co.

4. Colorado Interstate Gas Co., Colorado Springs.

A 385-mile, 22-in. line from connections with Pacific Northwest Pipeline Co. system at Green River, Wyo., to Denver. The line will utilize 9650 compressor horsepower, which includes a 4400-hp compressor station at Green River. Construction is expected to start June 1, 1955. Cost estimate: $25 million.

5. Colorado Western Pipeline Co., Denver.

328 miles of 16- and 18-in. line from La Plata county to Pagosa Springs, Del Norte, Redwing, Gardner, Pueblo, Colorado Springs, and Denver. Cost: $21.6 million.

6. East Ohio Gas Co., Cleveland.

A 113-mile, 30-in. line between Toledo and Cleveland, Ohio, to serve the company's distribution system. Construction was to have begun April 15, 1955. Cost: $10 million.

7. Iroquois Gas Corp., Buffalo, N. Y.

24½-mile, 20-in. line in Erie county, N. Y., to extend from compressor station in Elma to city gate station at Tonawanda, N. Y. Cost: $1,540,000.

8. Lone Star Gas Co., Dallas.

A 10.4-mile, 18-in. pipeline extension to North Fort Worth; a 21-mile, 18-in. line from Dallas to Collin county, Texas; an 8-in. loop line in Hopkins and Delta counties, Texas; a 10.6-mile, 6-in. line to Hollis, Okla., and Dodson, Texas, plus other routine construction. Total transmission budget of $2,546,300 includes $682,700 for line replacement, $55,000 for compressor stations and auxiliary equipment. Expenditures will be approximately 1/12th per month.

9. Manufacturers Light & Heat Co., Pittsburgh.

72 miles of 20- and 16-in. line, 38.7 miles of storage and well lines, 2 measuring stations, and a 1760-hp compressor station at the Victory storage field in Marshall and Wetzel counties, W. Va.; 75½ miles of 10-, 12-, 24-, and 26-in. lines and 4400 hp in new and additional compressor facilities in Washington, Allegheny, Chester, Lancaster, and Adams counties, Pa., and Marshall county, W. Va.; 61 miles of line and 1760 hp in compressor capacity on its system in Ohio, Pennsylvania, and West Virginia.

10. Montana Power Co., Butte.

A 75-mile, 12-in. line from Deer Lodge, Mont., to Missoula, Mont. Work is expected to begin on June 1, 1955.

11. Natural Gas Producers Inc., Colorado Springs.

A 48.7-mile, 10-in. line from northeastern Colorado gas fields to Colorado Interstate's 20-in. line, and 3 miles of 8-in. and 10.1 miles of 4-in. line to connect Adena field with Fort Morgan. Cost: $1,374,000.

12. Nevada Natural Gas Pipeline Co., Las Vegas, Nev.

An 11-mile, 10-in. line from Las Vegas

to Apex, Nev., and 33 miles of 8- and 6-in. line from Las Vegas to Sloan, Nev. Work was scheduled to start in April, 1955. Cost: $600,000.

13. Niagara Mohawk Power Corp., Syracuse, N. Y.

A total of 21 miles of new pipeline at a cost of $795,000. Proects will include a line from Waterford, N. Y., to Mechanicsville, N. Y.; and a line from Stanwix, N. Y., to Rome, N. Y. The company's transmission budget includes $130,000 for compressor stations and auxiliary equipment.

14. Pacific Gas & Electric Co., San Francisco.

An 18-mile, 12-in line in Colusa and Glenn counties, Calif., to bring additional gas into the middle Sacramento valley from two new fields. The line originates in the Beehive Bend area and extends south to a point near Princeton, then west to Gridley. Cost: $850,000.

15. Pacific Northwest Pipeline Corp., Houston.

A 1466-mile line from the San Juan basin in New Mexico and Colorado to markets in Washington, Oregon, Idaho, Utah, Wyoming, and Colorado. Included in the estimated cost of $160 million will be 433 miles of lateral lines, and 14 compressor stations with a total capacity of 104,420 hp. Construction is expected to start this spring.

15-A. South Georgia Natural Gas Co., Birmingham.

An 80-mile stretch of 6- and 8-in. line; 97 miles of 10-in. line; 110 miles of 6-, 8-, 10-, and 12-in. line; and 40 miles of 4- and 6-in. line—all in Alabama and Georgia. Total cost estimate: $8.6 million.

16. Southeast Alabama Gas District, Birmingham.

A "U"-shaped system of about 330 miles to serve southeastern Alabama. Owned by 14 municipalities, the system will also serve 10 other communities from connections with Southern Natural Gas Co. near Montgomery and Phenix City. Southern points of the line are Andalusia and Dothan. Cost: $18.3 million.

17. Southern Counties Gas Co., Los Angeles.

A 31.5-mile, 30-in. line beginning five miles east of Desert Center turbine station and extending to a point two miles east of the Cactus City plant. The line will complement a section of the California-Texas Biggest Inch pipeline. Cost: $2.5 million. In addition, the company has budgeted $287,000 for line replacement, and $108,000 for compressor stations and auxiliary equipment.

18. Tennessee Gas Transmission Co., Houston.

FPC has approved a 243-mile, 24-in. line from Hebron storage field in Potter county, Pa., to connections with existing facilities near Greenwich, Conn., and a 188-mile, 24-in. line connecting the Hebron field with the Harrison storage field in Potter county, Pa., and Steuben county, N. Y. Cost: $28.7 million. Tennessee Gas will also spend $14,647,221 in joint gas storage projects with other eastern gas companies.

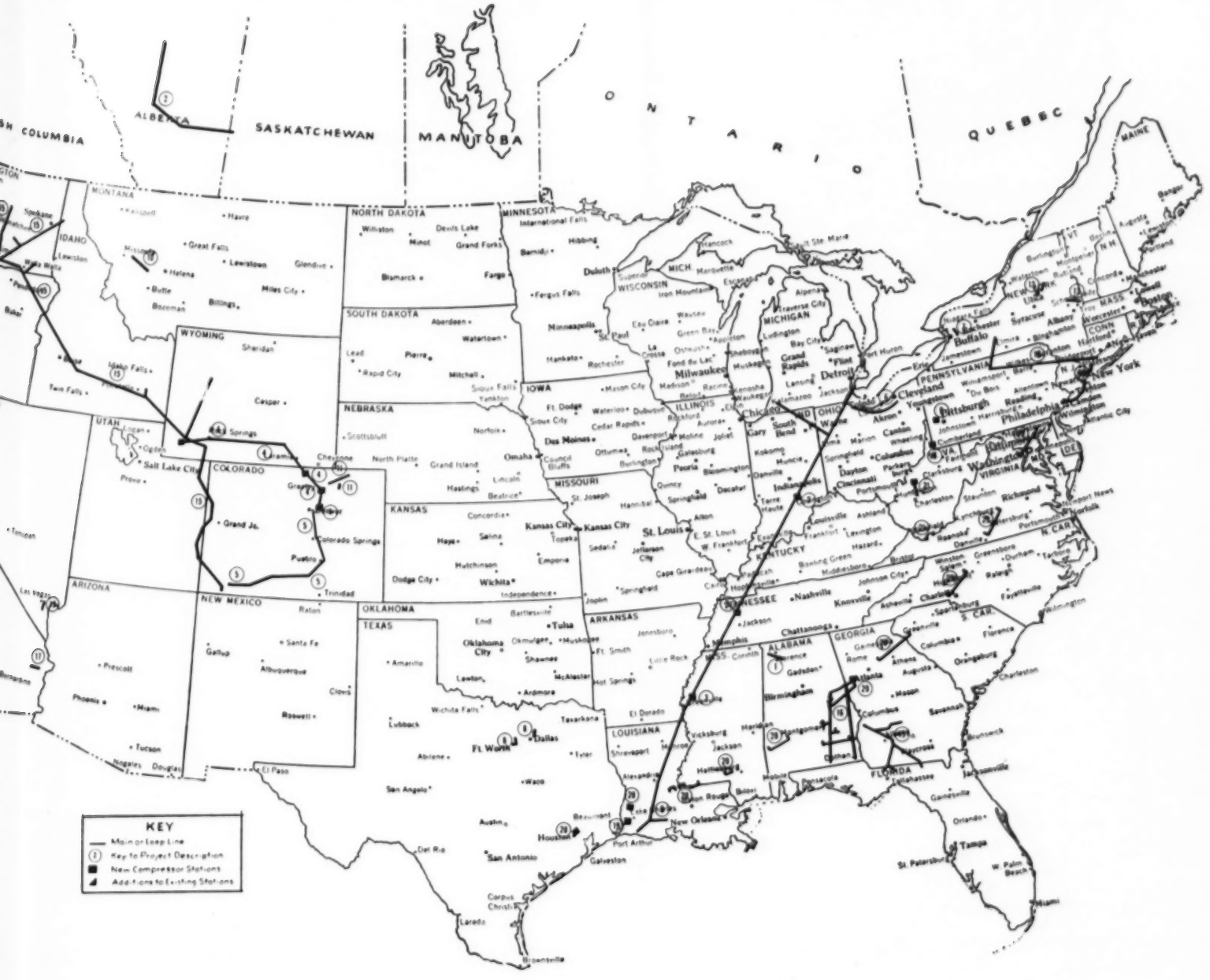
19. Texas Gas Corp., Winnie, Texas.

40 miles of 4-, 6-, and 12-in. extension lines connecting present facilities with a new line of Transcontinental Gas Pipe Line Corp. in Cameron parish, La. The project will include a large compressor station and measuring station near the Sabine river crossing. Cost estimate: $3.5 million.

20. Transcontinental Gas Pi Corp., Houston.

Will build 315 miles of 36 219 miles of 30-in. line, and of smaller diameter pipeline w struction scheduled to start 1955. The 30- and 36-in. li parallel the company's main

APPROVED AND UNDERWAY



al Gas Pipe Line

niles of 36-in. line, line, and 46 miles pipeline with con- to start April 1, 36-in. lines will ny's mainline for

about 45% of the distance between gas producing areas in the Texas-Louisiana gulf coast region and New York City. Additional crossing of the Potomac and Savannah will be necessary. Two new compressor stations will be built—one in Texas with 2500 hp, and one in Louisiana. Cost: $83 million.

21. United Fuel Gas Co., Charleston, W. Va.

An 18.4-mile, 20-in. line in Jackson and Wood counties, W. Va., from Ripley to Rockport compressor stations; and a 22-mile, 8-in. field line in McDowell county, W. Va. Estimated cost for both: $1,697,500.

GAS survey

• MAJOR PIPELINES PLANNED OR PROPOSED

1. Arkansas-Missouri Power Co., Blytheville.

Is building 18 miles of local transmission line at a cost of $225,000.

2. Atlantic Seaboard Corp., Charleston, W. Va.

70.14 miles of 26-in., looping existing pipeline between Cobb station and Baltimore. Total cost of $10,749,000 includes an additional 2000 hp to the Cleveland, W. Va., compressor station.

3. Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y.

Has set up a transmission budget of $398,000, which includes $170,000 for four miles of new transmission line, $123,000 for line replacement, and $105,000 for compressor stations and auxiliary equipment.

4. Central Kentucky Natural Gas Co., Charleston, W. Va.

A 14.2-mile, 24-in. line from Coldsprings measuring station to Cincinnati; and a 6.9-mile, 20-in. line, which would tap onto the Gulf Interstate transmission line and extend to the Means compressor station. Capacity of the Means station will be boosted by 1980 hp. Cost of entire program: $3,241,000.

5. Chicago (Ill.) District Pipeline Co.

A 16.2-mile, 30-in. extension to complete a 30-mile line from Joliet, Ill. to Chicago: Cost: $2,775,000.

6. Cincinnati (Ohio) Gas and Electric Co.

Will build six miles of transmission line at a cost of $521,400. The company will also spend $153,000 for line replacement and $178,000 for miscellaneous equipment.

7. Cities Service Gas Co., Oklahoma City.

A 93-mile, 26-in. line from Blackwell, Okla. to Grabham, Kan. Cost: $4,708,000. Also 145 miles of 20-, 16-, 8-, 6-, and 4-in. lines beginning at Alva, Okla., and terminating in Barber county, Kan. Cost of $3,353,200 includes 2700-hp compressor station. In addition, the company plans to build 52 miles of 10-, 8-, 6-, and 4-in. gathering lines in the Hugoton field. An estimated expenditure of $571,500 for this project includes 1350 additional compressor horsepower.

8. Connecticut Gas Co., Berlin, Conn.

Will spend $400,000 for new transmission line to serve its system.

9. El Paso Natural Gas Co., El Paso.

A 370-mile line from Mountain Home, Idaho, to Reno, Nev., to handle gas destined for California customers and supplied by Pacific Northwest Pipeline Corp. Cost: $35 million.

10. Houston Pipe Line Co., Houston.

Has budgeted $755,000 for new pipeline, $100,000 for replacement of line, and $100,000 for compressor stations and equipment.

11. Indiana Gas & Water Co. Inc., Indianapolis.

A $968,000 transmission budget includes $836,000 for 43 miles of transmission line, $65,000 for line replacement, and $67,000 for compressor.

12. Michigan Consolidated Gas Co., Detroit.

A 25½-mile, 12-in. line from connection with Michigan Wisconsin Pipe Line Co. line near Sparta to Muskegon, Mich., and a 32,000-hp compressor station for storage in Six Lakes field in Mecosta and Montcalm counties, Mich. Cost: $11.4 million.

13. Michigan Gas Storage Co., Jackson, Mich.

A 36-mile line from a point near Mt. Pleasant, Mich. to a point near Zilwaukee, Mich. Total cost of $2,665,200 includes $865,000 for compressor stations and auxiliary equipment.

13-A. Pacific Gas & Electric Co., San Francisco.

A 28.5-mile, 16-in. line from Marysville to Lincoln and from McClellan Field to North Sacramento to reinforce transmission system north of Sacramento; 7 miles of 20-in. line to complete the paralleling of Main No. 138 southwest of Helm; 60 miles of 12- and 10-in. line from the Topock-Milpitas line to Trona; 3.5 miles of 24-in. main in Oakland and Berkeley; and 33 miles of gathering lines. New compressor facilities will be built in the east and west Rio Vista gas fields, and additional compressor horsepower added in other parts of the system at a cost of $199,000. Total transmission construction: $5,123,000.

14. Michigan-Wisconsin Pipe Line Co., Detroit.

A system of 251.9 miles of 24-, 18-, 12-, 6-, and 4-in. loop lines, and an additional 3400 hp at compressor stations chiefly in Illinois. Total cost: $11,435,000. This construction program will enable Michigan-Wisconsin to purchase 100 MMcf of gas daily from American Louisiana Pipe Line Co.

15. Missouri Public Service Co., Warrensburg, Mo.

A 136-mile line from New Franklin, Mo. to Trenton, Mo. Work is expected to start May 1955. Cost: $3,012,868.

16. Natural Gas Pipeline Co. of America, Chicago.

A 350-mile, 20- and 26-in. line from Wise county, Texas, to Station 111 at Fritch, Texas. The new line will augment the company's gas supply. Con-

struction to begin July 1, 1955. Cost: $28,487,000.

17. Natural Gas Storage Co. of Illinois, Chicago.

A 31-mile, 36-in. line from storage field at Herscher, Ill., to point on the Texas Illinois line 12 miles south of Joliet, Ill. Construction is expected to start July 1, 1955. Cost: $5,140,000.

18. Northern Natural Gas Co., Omaha.

A 400-mile, 24-in. line from the United States-Canada border to a point near Minneapolis and two compressor stations with 5280 hp each. Cost: $56,786,000. The company would also build a 188-mile, 24-in. line to serve Duluth, Minn., Superior, Wis., and North Dakota, and install a 2000-hp compressor station in the Panhandle field. Also, a 9-mile, 30-in. line north of Clifton, Kan., and one 2000-hp addition at Sunray, Texas.

19. Northwest Alabama Gas District, Hamilton, Ala.

A Y-shaped, 114-mile line connecting with Southern Natural's System at Moore's Bridge, Ala., to serve Winfield, Boston, Haleyville, Bear Creek, Hackleburg, Hamilton, Guin, Sulligant, and Brilliant. Will transport gas for city of Fayette.

20. Oklahoma Natural Gas Co., Tulsa.

Has set up a transmission budget of $1,898,286, which includes $957,482 for 126.3 miles of new pipeline, $887,563 for replacement of line, and $53,241 for compressor stations and auxiliary equipment.

21. Panhandle Eastern Pipe Line Co., Kansas City, Mo.

A 58.3-mile loop line from a point near Springfield, Ill. to Peoria, Ill., and 48 miles of short sections of line to be built at various points on their system. Estimated cost: $3,605,210. In addition, Panhandle Eastern has budgeted $441,000 for line replacement, and $105,000 for compressor station and auxiliary equipment.

22. Peoples Natural Gas Co., Pittsburgh.

Will build 41 miles of local transmission line at a cost of $369,500. The company will also spend $205,400 for line replacement, and $100,800 for compressors and auxiliary equipment.

23. Philadelphia Electric Co., Philadelphia.

Will spend $1,808,000 for 13.6 miles of new transmission lines, and $50,000 for replacement of line, all in the Philadelphia service area.

24. Pioneer Natural Gas Co., Amarillo, Texas.

Irrigation laterals and local transmission mains totaling 538 miles at a cost of $5,880,000. In addition, $306,000 has been budgeted for replacement lines, and $570,000 for compressor stations and auxiliary equipment.

25. San Diego Gas and Electric Co., San Diego, Calif.

Has budgeted $550,000 for compressor stations and auxiliary equipment to serve its transmission and distribution lines.

26. South Jersey Gas Co., Atlantic City.

Has budgeted $547,000 for 19.1 miles of local transmission line.

27. Tennessee Gas Transmission Co., Houston.

Awaiting FPC approval is a 370-mile, 30-in. line from Station 1 near Aqua Dulce, Texas, along the shore line of the gulf coast of Texas and Louisiana to Station 507 near Kinder, La. The Kinder station is at the south end of the 576-mile Kinder-Portland line built in 1954. The new line will run through important gas producing areas, making new gas supplies available, not only from fields on shore, but from the vast off-shore tidelands area where exploration has only recently begun. Cost: $35.4 million.

28. Texas Gas Transmission Corp., Owensboro, Ky.

A 77.64-mile line from Covington, Tenn. to Jeffersontown, Ky.; a 115-mile line from Hardinsburg, Ky., to Bedford and Columbus, Ind.; 22,600 compressor horsepower, including one new station at Riverton, La., and a 13.61-mile line from Haughton station on Texas Gas Transmission line to valve No. 3. All three projects are scheduled to begin July 1, 1955. Total cost: $17.5 million.

29. Texas Eastern Penn-Jersey Transmission Corp., Shreveport, La.

Has budgeted $3,713,800 for transmission projects which includes $2,820,800 for compressor stations and auxiliary equipment.

30. Texas Eastern Transmission Corp., Shreveport, La.

A 216-mile, 24-in. line from Castor, La. to Kosciusko, Miss.; a 133-mile, 16-in. line from Beaumont, Texas, to a point on the Provident City-Castor line near Lufkin, Texas; plus an addition of 81,100 compressor horsepower to its system. Total cost: $82,265,800. Completion of these projects will allow Texas Eastern Transmission to reconvert the Little Big Inch back to oil service.

31. Trans-Canada Pipe Lines Ltd., Calgary.

A 2240-mile, 30- or 36-in. line across Canada from Alberta gas fields across the Prairies, around the Great Lakes to Ontario and Quebec with a line running off from Winnipeg to the U. S. border; 13 compressor stations totaling 94,160 hp. Cost: $300 million.

32. United Natural Gas Co., Oil City, Pa.

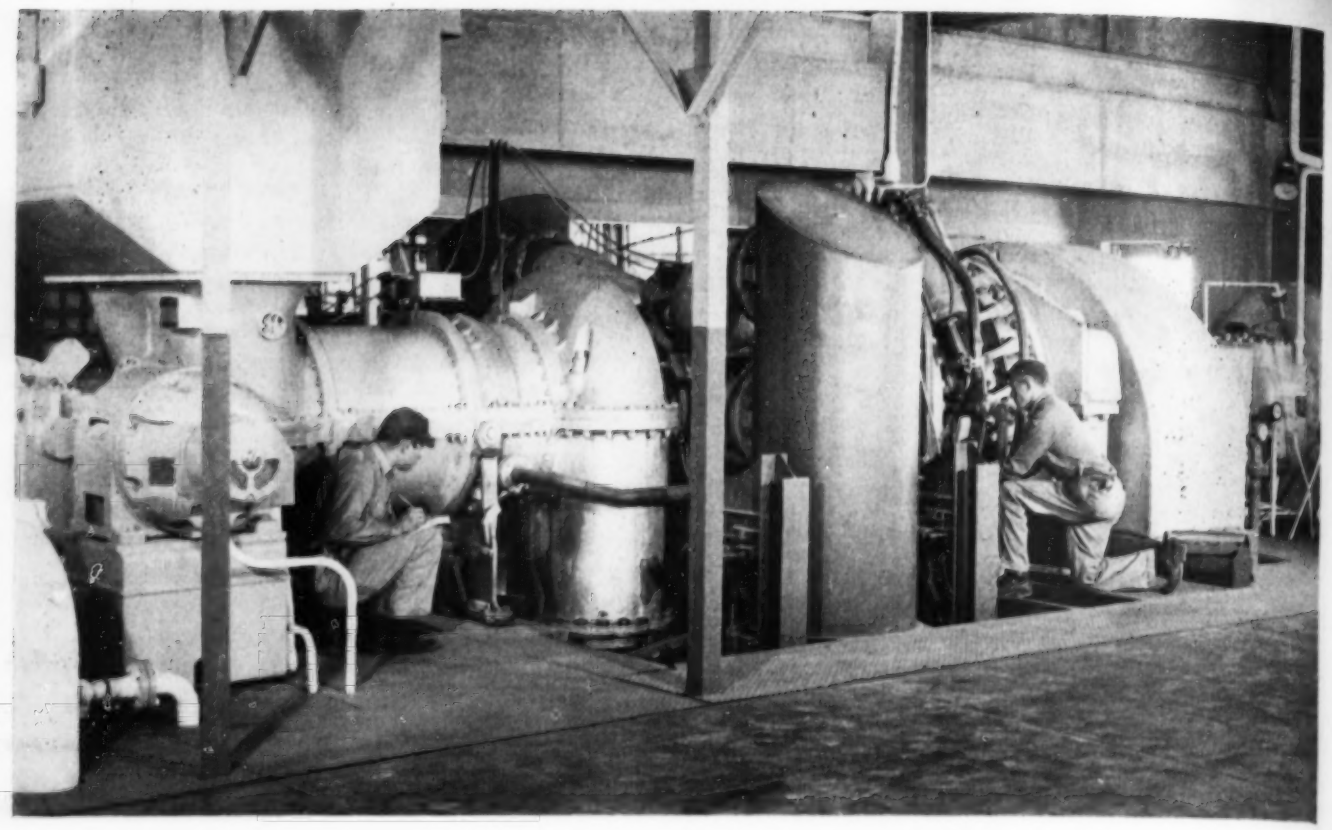
Has budgeted $1,008,000 for transmission projects, which includes $170,000 for 9 miles of new line, and $763,000 for replacement of line.

33. Westcoast Transmission Co. Ltd., Calgary, Alberta, Canada.

A 650-mile, 30-in. mainline from Peace river gas fields to Vancouver, B. C., and to the U. S. border where the line will connect with Pacific Northwest Pipe Line Corp. Of the $141 million total cost, $36 million has been budgeted for 1955.

34. Wilcox Trend Gathering System, Shreveport, La.

5.5 miles of 3-in. gathering lines in Dewitt and Victoria counties, Texas; a 16-mile, 16-in. loop line in Lavaca county, Texas. The company will install 2000 additional compressor horsepower to its system. Total transmission expenditures for 1955: $3,144,300.



"Compressor station maintenance is good business"

IT'S spring.

Spring—the time for a general housecleaning, when housewives throughout the nation are going over the house from attic to basement with mop, bucket, and carpet beater.

For the compressor station superintendent, spring doesn't have that much meaning. While the easing of the weather makes it simpler to take boosters off the line for extensive maintenance and repair, he has actually been concerned with preventive maintenance the whole year round. Modern gas transmission line compressor stations are maintained on a continuous basis. The operating department wages a constant war against deterioration of stations and their mechanical equipment. Preventive maintenance, coupled with periodic overhaul, is now an integral part of operating policy.

For its distribution system maintenance issue, *GAS* proved its point that MAINTENANCE IS GOOD BUSINESS. We believe that this phrase holds true for the pipeline companies as well, and it is particularly suited when thinking in terms of revolving, reciprocating, constantly-in-motion mechanical equipment in compressor stations. With but slight modification, we propose — COMPRESSOR STATION MAINTENANCE IS GOOD BUSINESS!

Modern methods emphasize preventive maintenance

By J. FRED EBDON • Managing Editor

COMPRESSOR stations can accurately be called the hearts of gas transmission lines. Like the human heart, they produce the energy required to move fluid through conduits to the desired destinations, but unlike the human organ, each transmission line usually has more than one compressor station composed of several compressor units. This allows one or a group of engines and/or compressors to be taken out of operation for needed repairs and maintenance. Further, this ability to practice preventive maintenance and make repairs as required practically removes any estimated limit of longevity for compressing equipment. Under a good maintenance program, obsolescence is the only basis for engine or compressor retirement.

Down time and the replacement of parts or units in compressor stations is expensive. In addition, it is costly to the operating company because it usually means some interference with the work of gas transmission, it decreases plant capacity temporarily, it may result in loss of some revenue, and it may well involve the payment of overtime wages. Preventive maintenance can reduce these expenses. The old concept of running equipment until it stops was discarded long ago by most astute operating managements. The ability to anticipate trouble before it causes damage is far more important to the present owners of modern high-speed compressor equipment than the ability to straighten out messes and repair wornout or replace damaged parts. The men in the field, operators and engineers, should also obtain greater satisfaction out of preventing trouble than fixing the results of it.

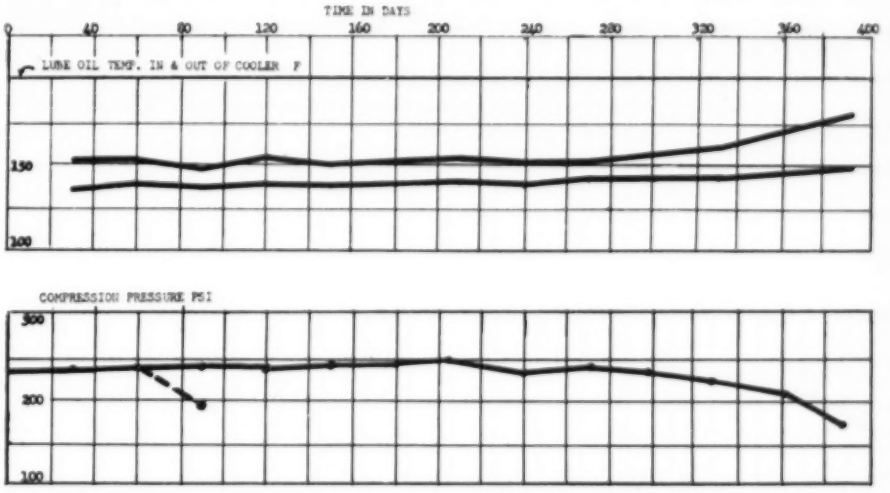


Fig. 1 (top). Running record of performance of lube oil coolers. Top plot shows the temperature into an oil cooler; the lower plot shows the outlet temperature from the cooler.

Fig. 2 (bottom). This curve would indicate when compression pressure begins to drop because of wear, sticking, or scuffing of piston rings.

AIDS TO A PREVENTIVE MAINTENANCE PROGRAM

Some compressor stations are designed to facilitate close checks on the operating equipment so that performance data can be easily collected. Other stations have had practices included in their design that represented false economy; for example, some designers have found it convenient to leave out drain and testing fittings during the original construction. Operating personnel and maintenance crews will vouch for the imprudence of such frugality. They know that the manufacturers of compressor station equipment have produced machines that are marvels of design and operating performance, but as in the case of all mechanical devices, they will break down eventually—on occasion, prematurely. Therefore, the station should be designed on the assumption that the equipment will not always operate according to plans.

Drains, pressure taps, thermometer wells or other temperature indicator facilities, etc., can be inexpensively installed during construction stages, but if they are overlooked until operating experience indicates that they are necessary, shutdowns or hot taps are required to effect installation.

Thermometer wells: Thermometer wells should be installed at every loca-

Compressor maintenance... Loss of compression pressure can mean valve trouble

Fig. 3 (top). Blowby can be detected by the use of pressure gauges and adequate records. The curve here shows an increase in lubricating oil consumption, adding to the suspicion of the presence of blowby.

Fig. 4 (bottom). Graph of the property as shown here would be advantageous because blowby would result in an increase in the crankcase pressure.

tion where the temperature of lubricating oil, fuel gas, process gas, air services, or water undergo changes by compression or blending, or by passing through coolers, heaters, or other auxiliaries. As a minimum design standard, thermometer wells are needed at:

(1) The suction to each stage and the discharge from each cylinder.

(2) The cooling water outlet for each compressor cylinder.

(3) The cooling water inlet and outlet for each bank of power cylinders.

(4) The cooling water inlet and outlet for each lubricating oil cooler.

(5) The lubricating oil inlet and outlet for each oil cooler.

(6) Points where the only method of determining flow rate of water, gas, or oil is by a comparative use of relative temperatures.

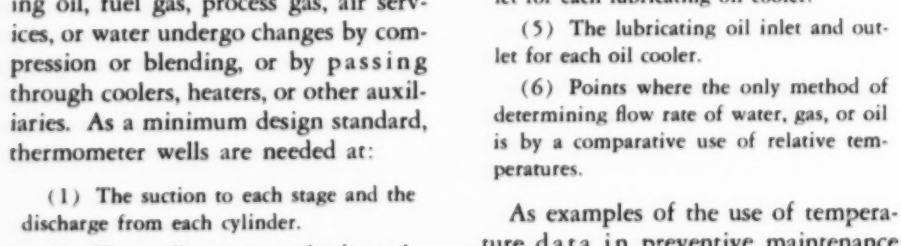
As examples of the use of temperature data in preventive maintenance work, the following are cited:

(1) The performance of lube oil coolers can be followed by the use of a running record such as the chart shown on *Fig. 1*. The top plot shows the temperature into an oil cooler; the lower plot shows the outlet temperature from the cooler. When the plots start to diverge, it is an indication that the cooler is dirty and should be cleaned. The first preventive step would be to check the water treatment and inhibiting processes to prevent the collection of foreign material and the formation of scale.

(2) If the gas discharged from one compressor cylinder has a higher temperature than has the gas discharged from another doing the same work, it is probable that a cylinder is malfunctioning. This detection method will not give an indication of what is wrong with the cylinder, but it does serve as a warning that there may be a faulty suction or discharge valve or that leaky piston rings are allowing blowby.

Pressure taps: Blowby is one of the most serious and recurring problems in compressor engine operation. This condition can be detected by the use of pressure gauges and adequate records. The curve plotted on *Fig. 2* would pictorially indicate when compression pressure begins to drop because of wear, sticking, or scuffing of piston rings, which would cause one to suspect blowby. The curve on *Fig. 3* showing an increase in lubricating oil consumption would add to the suspicion of blowby. Then, too, blowby would result in an increase in the crankcase pressure, so a graph of the property as shown on *Fig. 4* would be advantageous. These charts show the average for the compressor cylinders; hence, they reflect the wear in a general way and provide ample warning of piston ring deterioration so that a changeout program can be planned well in advance of absolute necessity. If the compression pressure for an individual cylinder showed a marked decline, it could be plotted on the same graph separately so that more frequent checks and an early inspection could be made. Loss of compression pressure can mean valve trouble in four-cycle engines.

Carbon formation at suction or discharge valves, or in lead lines to or from a compressor, is another problem that vexes most station operators. The effect of the clogging on the pressure within the cylinder is difficult to evaluate. A simple device to measure this pressure has been suggested. A small pressure bottle, made of 2-in. pipe capped at both ends, can be fitted with



Valve maintenance is needed to free suction and discharge valves of carbon deposits.

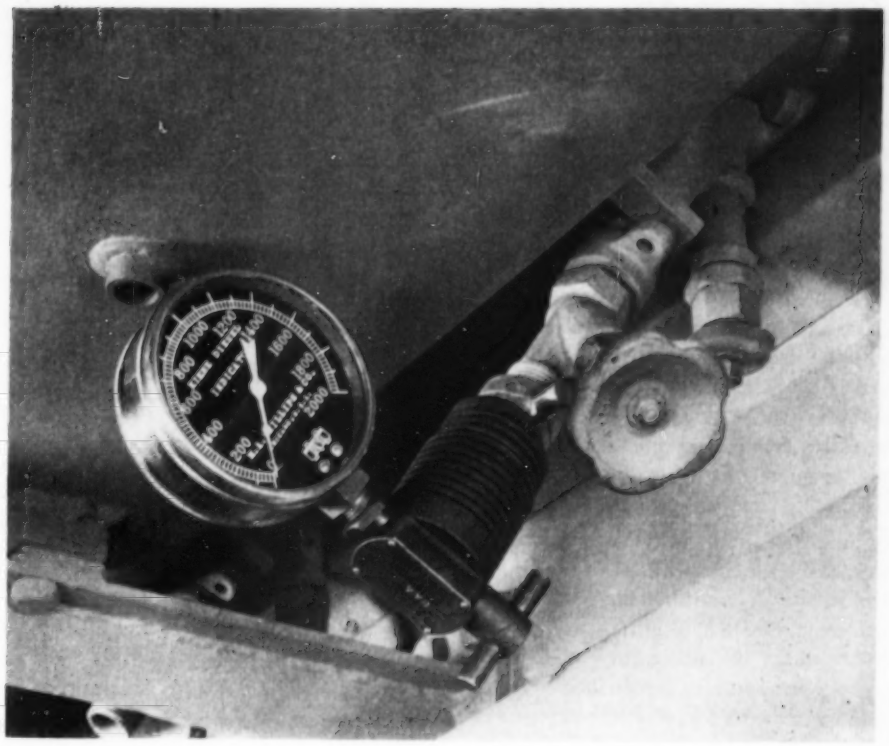
a pressure gauge on one end and a small inlet line on the other. The inlet line should have a check valve and a block valve in it. The apparatus is then installed in an indicator plug hole on the cylinder and the unit operated in its normal manner. The pressure gauge will measure the highest pressure experienced in the cylinder if the check valve is installed so as to allow flow into the bottle. Conversely, if the check valve is reversed and the bottle filled with high-pressure gas, the device will indicate the minimum pressure encountered in the cylinder.

Drains: Drains can be used to collect data. For instance, if the stubs into suction compressor cylinder volume bottles extend into the bottle a couple of inches and the bottle is provided with a drain outlet and valve, liquid carry-over from the process gas inlet scrubbers can be recorded. This will produce a check on the efficiency of the scrubbing operations, or, if it is known that an expansion and resulting temperature drop is occurring in the gas between the scrubber and the bottle (this could cause liquid formation even when the scrubbers are operating at their rated efficiency), the recorded liquid collection at the volume bottle drain will at least indicate the condition of the gas as delivered to the compressor cylinders.

Pyrometers: The use of pyrometers, installed with thermocouples mounted near each exhaust port, will frequently give an indication that something is amiss in an engine, but they will not actually locate the trouble. They have long been used with large diesels, and more recently with both two- and four-cycle engines. Investigation shows that their main value lies in tipping off the operator that an irregularity exists; there is disagreement over whether they should be used to determine such things as, for example, unbalance of a two-cycle engine.

Pyrometers give an indication of load conditions, but other instruments should be used to confirm this quick method. "Pull cards" are recommended by most engine manufacturers. The exhaust pyrometer is an excellent tool, however, for locating faulty spark plugs, coils, condensers, points, and exhaust valves. This is particularly true in the case of two-cycle engines.

Other aids: Recording card-type engine indicators are a rather expensive, though very useful, medium for estimating compressor engine performance. Their application to the older horizontal type units was much simpler than is their use with the angle and V-type engines. An experienced technician is required to manipulate and interpret them, but they produce worthwhile data in the form of a permanently recorded existing pressure pattern.



Devices such as the portable indicator shown above are particularly useful for checking four-cycle engines for proper fuel adjustment.

Other helpful devices for preventive maintenance for gas compression equipment are:

(1) Average and maximum pressure indicators—these have a number of applications, such as indicating average or maximum peak explosion pressures, etc.

(2) Mercury-filled manometers—these can be used advantageously for measuring scavenging air pressure, intake manifold vacuum, etc.

(3) Portable combustion indicators—devices of this sort are particularly useful for checking four-cycle engines for proper fuel adjustment.

(4) Neon glow-bulbs—these inexpensive tools are useful for checking relative voltages and milliamperage in non-metallic, shielded, high-tension ignition system conductors.

(5) Neon timing lights—such instruments can be used for their designed purpose without interfering with outputs from conventional ignition systems.

(6) Mechanical auscultators — with these an interested engineer with experienced ears can listen to an engine and easily pick up unusual sounds in its operations that may mean trouble.

NON-DESTRUCTIVE TESTING

Non-destructive testing equipment is another physical factor that can vitally affect maintenance around a compressor station. Some of the companies that make this equipment market it for direct sale, others offer their service on a rental or contract basis; other companies will sell or rent their equipment and rent the services of their technicians. Many compressor station operators have had excellent results with in-place testing by non-destructive methods. In general, an oily-paste that has fluorescent ferromagnetic particles suspended in it is applied to the part being inspected. A magnetic field is then induced in the part. Discontinuities in the structure of the part cause sudden interruptions in the magnetic field and locally crowd some of the flux outside of the part. The resulting leakage fields attract and hold some of the suspended magnetic particles. When the part is examined under black lights*, the resulting fluorescence from the metallic particles gives a definite indication of the location, shape, and extent of any discontinuities.

*A popular term applied to the invisible radiant energy in that portion of the ultra-violet spectrum just beyond the blue of visible light. It is in the range between 3500 and 4000-Angstrom units.

LUBRICATING OIL MAINTENANCE

Probably the foremost factor in preventive maintenance is the care and handling of lubricating oils. Oil can be and is contaminated in many ways. Blowby, no matter how slight, carries carbonaceous material formed by incomplete combustion in the power cylinders into the oil in the crankcase. Dust and dirt sucked into the scavenging air also wind up in the crankcase oil, as do particles of metal worn from cylinder walls and pistons. The fuel may also deliver entrained contaminants to the oil.

Detergent oils hold the contaminants or disperse them until normal circulation carries them to filters where all but the smallest contaminating particles are removed, but it is essential that an adequate flow of lubricating oil at the proper temperature is provided to transport contaminants away from cylinders, rings, and pistons. The quality and temperature of this oil must be constantly maintained; however, what is the best lubricating oil temperature is a controversial point. Temperatures ranging from 120° to 180° F have been advocated, but incorrect temperatures are known to cause crankcase dilution or sludge or varnish formation.

Most experts have set optimum oil temperatures between 140° to 160° F, so perhaps the best solution is in the range of from 150° to 160° F. At these temperatures, the pistons expand less than the cylinders, so proper cylinder-piston clearances are maintained. A jacket water temperature in the range from 155° to 170° F will assure the proper action in the metal of the parts and help prevent condensate in the crankcase. Pressure gauges upstream and downstream of the oil filter(s) will indicate an unusually large pressure drop, which, in turn, gives warning that clogging has occurred and indicates the necessity for cleaning or changing filter elements.

Lubricating oil line piping can cause a lot of trouble. Most bearing manufacturers feel that dirt causes many of the bearing failures. Mill scale from black iron pipe, and zinc that sluffs off of galvanized pipe, can cause this sort of failure. Welded steel pipe and fittings can produce mill scale, welding slag, and spalls that may find their way into the lubricating oil and cause bearing trouble or clog filters; however, the welding fittings and spools can be pickled after fabrication to eliminate, to a greater or lesser extent, this hazard. The best material for lube oil piping is largely a matter of personal opinion, but the piping must be carefully considered lest it become one more source of contamination. The whole problem of oil care actually resolves about interrelation factors; that is, contaminants tend to lodge in varnish formed on lubricated parts. The varnish is generally formed by excessive oil temperatures and the net result is usually lapping action on bearing journals; so, each phase in the maintenance of lubricating oil is important.

Low oil level, a broken oil pump, clogged filters, a dirty suction strainer, a loose oil line connection, a faulty oil pressure regulator, etc., can all cause low oil pressure. The presence of unusually heated areas and the appearance of babbitt being forced out the sides of a bearing are warning agents that can usually be found during a crankcase inspection if something has gone amiss in the lubrication system. A little air pressure on the oil system, when the crankcase doors have been removed, will aid in locating bearing leakage. Small leaks are not evidence of serious trouble, but a large volume of leakage indicates a bad bearing. If this is not the trouble, it is likely an oil pump has broken down.

Basically, it is well for the station operator to be guided by the condition of the engine, filtering elements, oil pressure gauge readings, and the pH or neutralization number and percent of insolubles in the oil as revealed by laboratory analysis.

THE AIR INTAKE SYSTEM

An efficient air filter is standard equipment on modern installations. Again, the prevention and elimination of foreign material is of prime importance. In line with this, the piping system and welded joints should be jarred to remove any mill scale or other foreign material and then blown down with compressed air. Pressure gauge or manometer readings across the air intake filter should be made periodically to assure that the pressure drop through the element does not exceed that recommended by the manufacturer. The frequency for scheduling cleaning can be ascertained from a log of the manometer readings.

THE STARTING AIR SYSTEM

Moisture is the major source of trouble in starting air systems. However, contamination in general must be prevented by making sure that the piping is free of metallic particles and other foreign material when it is installed for service. After clean piping is installed, there is the inevitable problem of entrained moisture if nothing is done or installed to provide preventive maintenance. Engines do not use their starting air system very often, so moisture that forms in the lines has ample opportunity to collect in valves, low spots, other mechanisms, etc., and produce considerable corrosion. Several methods have been used to combat this problem: drips or drain pots have been installed

Preventive maintenance on starting air systems should reduce corrosion from entrained and collected moisture.

on engine air headers, various types of air dryers have been tried, and fine oil sprays have been injected into air systems from oil atomizers.

ENGINE AND COMPRESSOR CYLINDER COOLING WATER

The latest trend in cooling systems is for increased water temperatures.* Vapor phase cooling is not new, but it has been rather slow to catch on. There are still plenty of arguments for lower cooling water temperatures and there are many good engine men who remain to be convinced, but temperatures in excess of 212° F may be ideal. It is certain, however, that the temperature of the jacket water should be higher than that of the lubricating oil. Clearances between the piston and cylinder walls depend upon the maintenance of jacket water at temperature in excess of 150° F.

Compressor cylinder cooling water temperatures are usually maintained at relatively low values so that some of the heat from gas compression is removed. This produces greater efficiency; however, when wet gas is being processed, the temperature of the water cooling the compressor cylinders must be high enough to prevent condensation in the process gas and cylinders. In this case, the compressor cylinder water should be maintained above 150° F.

The volumes of water passing to the engine jacket and the compressor cylinders should be carefully measured and controlled. Frequent temperature readings should be taken in the cooling water system. These should be logged so that a progressive reduction in cooling effect can be observed. A scaled-up cooling system can result in scored cylinder heads, etc., so it is well to keep the cooling water clean and accurately treated.

Calcium carbonate or limestone-like hard scale will greatly reduce the efficiency of heat transfer surfaces and may clog water flow passages unless proper maintenance is applied. In addition to this, algae and slime are often problems in cooling water. Proper water treatment, then, involves removing the scale-forming constituents or at least holding them in suspension, preventing the formation of slime and sluge, controlling the pH value to protect the wood of the cooling tower, and inhibiting the metallic parts through which the water is circulated. In line with the latter, good preventive maintenance will eliminate regular aeration of the cooling water to prevent the formation of the corrosive conditions that cause iron oxide deposits in the engine and compressor jackets. Water is commonly aerated by falling freely from an entry point, in a vessel, to the maintained water surface some distance below. A maintenance program should not overlook the elimination of points where aeration could be happening.

*See "How Large Compressors Utilize Vapor Phase Engine Cooling" by L. C. Harbert, *GAS*, August 1954, p. 91.

THE FUEL GAS

Any gas-fired engine produces its optimum power when fed with clean, dry, fuel gas that has a constant heating value. Often, however, wet gases are used, so scrubbers must be maintained in good condition or they fail to produce their designed job.

Modern engines are very efficient, but they must be supplied with liquid-free fuel gas. Liquid carry-over from the scrubbers is particularly troublesome. Solids in fuel gas will also make maintenance costs soar, so additional filters downstream from the scrubbers will be a valuable investment from the preventive maintenance point of view.

OPERATING PRACTICES FOR PREVENTIVE MAINTENANCE

Only a few specific preventive maintenance points have been mentioned because of the complex nature of engine and compressor mechanisms. There are many more important points for the various operating devices and processes. Perhaps the one that cannot be overstressed is the lubricating oil system. It is the key to many compressor station problems. Observance of the lube oil properties can serve as a check on the operation of several important parts. For instance, bearing trouble can be detected or at least suspected if lubricating oil pressure drops. This is particularly true in the case of the slow running engines; however, in faster running engines with thinner babbitted bearings, the babbitt may flake off, fail completely, and damage journals before filters and strainers show much evidence of a change in the relationship between the connecting rod bearings and main bearings clearances.

Both two- and four-cycle engines are sensitive to adjustment and tinkering. They react in diverse ways to maladjustment, so it is wise to study problems as they arise rather than attempt various cut-and-dry techniques. Often the reaction of a particular engine is misleading. An an example, the governor may hunt if the cylinders become unbalanced. Some engineers would be quick to say that the governor is at fault when actually its operation is as designed. An engine well balanced at or near its capacity will not always appear to be in balance at slower speeds and lighter loads. There may be some intermittent detonation or even very annoying pinging under this situation. In all cases, adjustment of the cylinder balance is not the answer. Fuel gas pressure, scavenging air pressure, blower valves, and the condition of the air cleaner and cylinder parts should be checked before the balancing valve is adjusted. The balancing valve, once it is properly set, should remain in perfect setting for a long time before readjustment is required.

The fuel volume usually changes more in relation to load than does the air supply, so the mixture may become richer under increased load. Detonation will usually occur when this condition is encountered. The same is true for an individual cylinder on the two-cycle engines if one or more of the adjusting valves is not properly set. Also, in the afternoons of warm days, the reduced density of the intake air, caused by relatively high ambient temperatures, may make the fuel-air mixture too rich and result in detonation. Cooling and intake air is a solution to this problem. Again, the solution does not depend on adjusting the cylinder balance.

The ignition system should also be checked before the cylinders are judged unbalanced. Faulty ignition to one cylinder may cause another cylinder to be overloaded and produce detonation. After the ignition system is functioning normally, the gas regulating valve should be properly set to admit constant pressure as required.

Preventive maintenance should include a reasonable warm-up period to allow internal parts to attain operating temperature before loading is applied. Also, idling for a short period before shutdown will minimize carbon deposits in the ports and on piston heads. Carbon on intake ports can cause a reduction in air supply to the cylinder and detonation may be produced from resulting rich mixture; these carbon deposits may be the result of excessive or faulty lubrication. Inadequate cooling by the circulated water can result in hot spots, which can result in detonation.

Overloads are a serious contributor to higher maintenance costs; these can be spotted by frequent horsepower checks. Close attention to pyrometer readings can be used to indicate minor trouble and/or warn of unbalance.

The station personnel should be cautioned repeatedly that designed speed should be maintained to prevent operation at slower speeds under conditions that would produce an overload condition at rated speeds. Pockets or lifters would then be used to operate in relation to load variations.

THE OVERHAUL PROGRAM

Preventive maintenance can go a long way toward reducing operating costs and eliminating down-time for repair and overhaul, but in spite of all maintenance efforts, compressor station equipment will have to be periodically overhauled to increase operating efficiency and longevity. There have been many fine papers written on methods for the determination of the ideal timing for compressor overhauls, so that subject will not be covered in detail herein. It should be obvious that a great deal of data gathering, record keeping, and information processing is required to accurately determine the point at which overhauls become a paying proposition. With the advent of high compression ratios, high-speed units, supercharging, etc., many companies have found that the overhaul schedules worked out on the basis of the older, slow-speed engines have had to go out the window. Also, with the power units used prior to the war, there was not much variance among the overhaul periods for the various types of engines used; now, each type of power unit must be considered separately. For instance, the overhaul period for a gas combustion turbine will not prove feasible for large, slow reciprocating engines. Nor will a program of semi-high-compression reciprocating engines work out in all cases for high-compression engines.

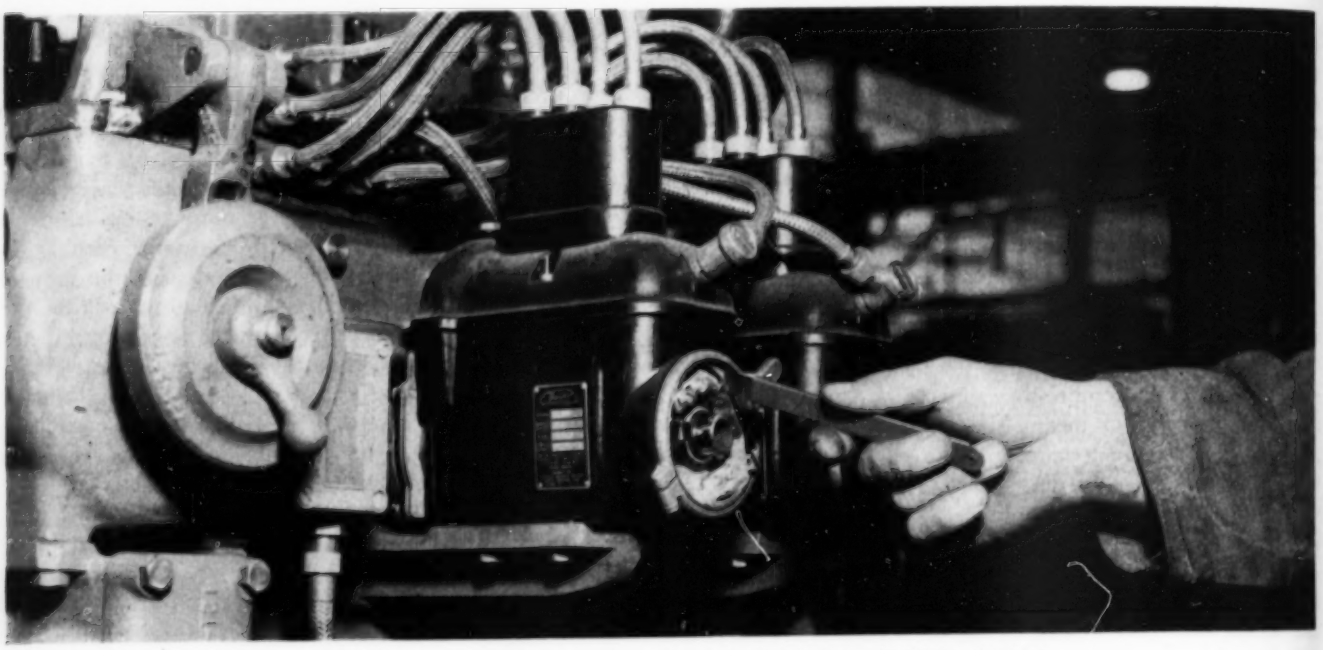
Another change is occurring in overhaul philosophy: that is, there is a trend toward scheduling them for the spring season rather than during mid-summer. Some compressor men now think that the intense heat encountered in most areas (are our summers getting warmer?) is a greater source of wear and deterioration than are the peak loads of the winter. Hence, they would rather have their equipment in the peak operating condition for the rigorous summer season. Also, the man-hour efficiency of overhaul crews is improved when this heavy work is done during a relatively cool season. The loads may be least in mid-summer, but they are generally at least considerably reduced in the spring.

Special time- and labor-saving tools should be applied to any compressor overhaul operation. Impact wrenches save money when applied to disassembly. Torque wrenches are particularly valuable on reassembly work; for instance, when bearings are being replaced in reciprocating equipment, the bearing cap may be distorted unless the dowels are inserted correctly and carefully and torque wrenches are used to tighten the bolts evenly and progressively. Precision tools such as micrometers, surface gauges, combination sets, scales, squares, etc., are musts.

Portable scaffold-type overhead platforms are invaluable for storage of upper gear while compressors are being worked over. In line with this, good job-rated hoisting equipment can pay for itself when heavy parts must be lifted for removal or installation. Proper slings, shackles, etc., should be provided so riggers can sling loads efficiently and safely.

Jigs should be provided for jobs such as fitting compressor and scavenging rod packings, bearing liners, etc. Parts racks, gasket boards, and portable units for tool storage and work benches will also save money in the long run.

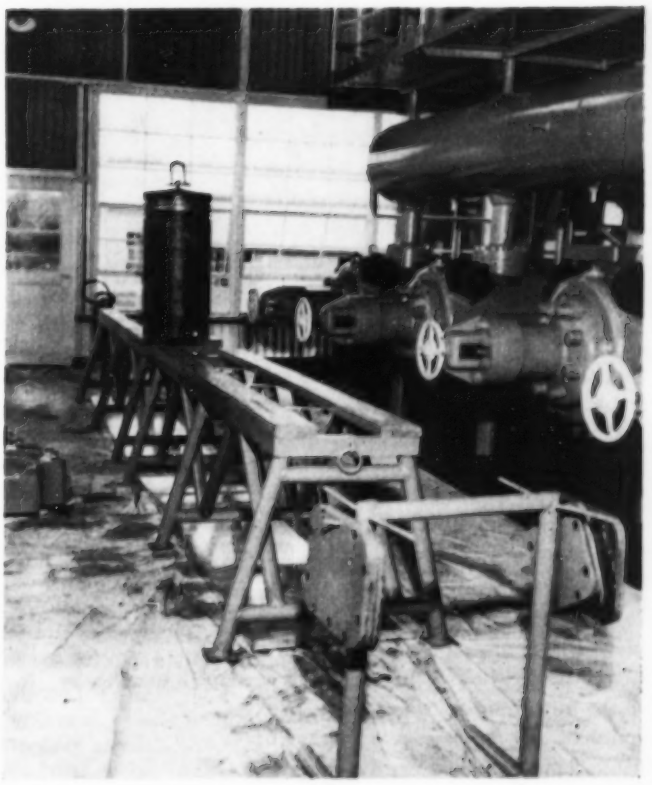
Semi-high-compression units are usually overhauled after they are operated between 8000 and 12,000 hours. Perhaps 10,000 hours is as good an average as any. High compression units usually require an overhaul at about 15,000 hours. This is because the high compression units utilize the results of later research in their design and the higher compression ratio, improved power pistons, improved power cylinders, larger crankshaft with precision bearings, and larger scavenging cylinders, etc., permit less frequent overhauls.



Before cylinders are judged unbalanced, the ignition system should be checked.

GAS exclusive

Transco puts faith in 30-day inspections and annual overhauls



Before the annual overhaul, labor-saving devices such as the power-piston rack, shown in the center, are constructed. This rack serves as a place to clean and measure pistons and store them while work is being performed on the engine.

By F. B. HAVERFIELD
Superintendent of Compressor Stations
Transcontinental Gas Pipe Line Corp., Houston

ALTHOUGH the factors involved here are directed primarily to the practical maintenance of mainline compressor units on long-distance transmission lines, they could be applied, in measures, to any operating machinery.

Since the inception of this type of operation there has been a real need for a more definitive maintenance program than has generally been applied by the industry. The methods of preventive maintenance that were originally developed to be used in connection with the slower speed machinery were good, but these methods were not effective in their entirety in the application to modern units that are now in use on many pipelines.

In connection with this problem, a review has been made of the preventive maintenance and overhaul procedures for the mainline gas engine compressors to fit the needs of Transcontinental Gas Pipe Line Corp.

This pipeline is being operated under a high load factor. There is substantially no difference between the summer and winter loads. Therefore, outages that result in loss of compressor horsepower hours become of great importance.

The basic theories of operating compressor horsepower on a mainline are to carry on a program so that the maximum horsepower can be developed at a minimum cost.

The Transco system is entering its fifth year of operation. In the initial period it became apparent that the load factor would be high and that outages resulting in loss of horsepower would curtail sales and affect revenue. Therefore, it was of prime importance to develop a plan that would result in maximum efficiency.

Minimum downtime

The problem was approached on the theory that if the running life of equipment could be determined and remedial measures taken before actual failure occurred, the net result would be minimum downtime and minimum cost. Another important factor was the skill available. This company has seen fit to give all of its operating personnel an opportunity to be a part of the maintenance program so that their training in the operation and maintenance of the equipment could be greatly accelerated.

Continuous plan

To carry out the ideas presented previously, a continuous preventive maintenance plan was developed. It has been found that monthly inspections of each unit are necessary. On this particular pipeline these inspections are referred to as "30-day checks." Each unit is shut down, the spark plugs are changed, the ignition is thoroughly checked, the filters are inspected, scavenging air systems are inspected and all vulnerable parts in the engine are checked. Each week, and more often if necessary, the units are balanced. Careful logs of the findings are maintained on individual units and at the end of

Compressor Maintenance . . . Selection of time for the overhaul is important

each monthly period an analysis is made by stations of engine downtime and the causes.

Transcontinental's operating staff made an arbitrary decision based upon studies of the individual logs and from the experiences of others that engines on this system should not be run longer than 9000 hours without having a complete overhaul. They further proceeded on the theory that if an engine was completely overhauled each 9000 hours, it probably would run for an ensuing 9000 hours with no major outages. On this basis they have proceeded in their overall plan of total maintenance. This involves, as stated before, their running maintenance, the 30-day checks, and an annual overhaul.

The first step in planning the annual overhaul is developing carefully laid plans to accomplish the work required in the minimum of time, with the maximum of efficiency, and with the minimum loss of sales. This involves a carefully coordinated operation between the various departments in the company. Selection of time for the overhaul, considering weather, vacation schedules, etc., is important.

Basic planning for the overhaul includes the following:

(1) A meeting of the repair foremen and the station superintendents in each of the divisions is held.

(2) A survey of the spare parts needed at each station is made and the material is ordered in sufficient time to be on hand before the overhaul starts.

(3) Transco's operating management selects a date to start the overhaul. This date is chosen by taking into consideration both the effect of the work upon gas sales and the man-hour efficiency gained by completing the work before hot weather.

(4) Preliminary to the overhaul, various labor saving devices, such as work platforms, tool and parts' racks, special jigs and dollies, are constructed where needed.

(5) Arrangements are made with the pipeline department for any extra labor that will be required. In addition, arrangements are made for various service engineers and inspectors, if needed.

(6) Coordinated planning is undertaken to have outside machine shop facilities at Transco's disposal as the need is anticipated.

(7) Plans are made with the aviation department and the pipeline department for the rapid movement of material and personnel by plane and truck as the need might arise.

In addition, the following decisions were made prior to the first annual overhaul and have been carried out during all subsequent overhauls:

(1) Engine overhauls are conducted simultaneously at all stations.

(2) Overhaul work is performed on a round-the-clock basis.

(3) Day-to-day progress reports on each engine are made to flow to Houston and to divisional offices. In this manner supervisory personnel and management can modify planning and coordinate activities as the need arises.

(4) A careful estimate is made of the time required for the overhaul of each unit.

In brief, the following work is to be performed at the reciprocating stations:

(1) Power pistons and connecting rods are pulled.

(2) Carbon is cleaned from scavenging system parts and ring grooves.

(3) Compression and oil rings are examined and replaced where necessary.

(4) Major vulnerable engine parts are magnafluxed in place for defects.

(5) Power pistons and cylinders are checked for wear.

(6) Main bearing caps are pulled and the bearings inspected. Crank pin bearings are also checked.

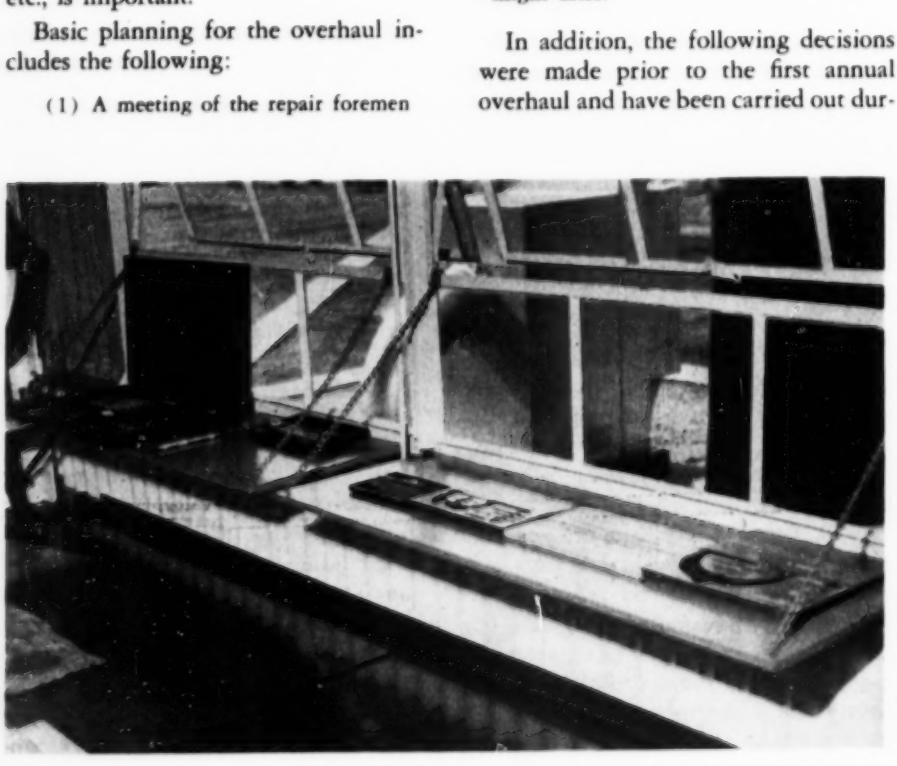
(7) Deflection readings are taken on the crankshafts.

(8) Drive chains, spark plugs, interrupters, wiring, oil lines, etc., are checked.

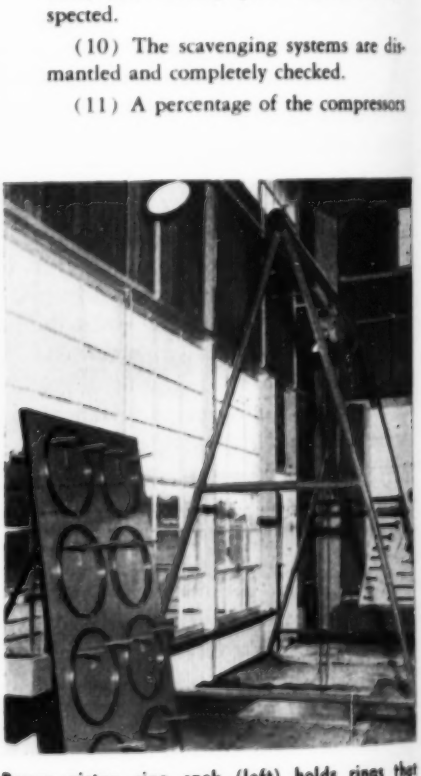
(9) Fuel and air valves are ground; fuel timing checked; gas valves, governors, and starting pilot valves are inspected.

(10) The scavenging systems are dismantled and completely checked.

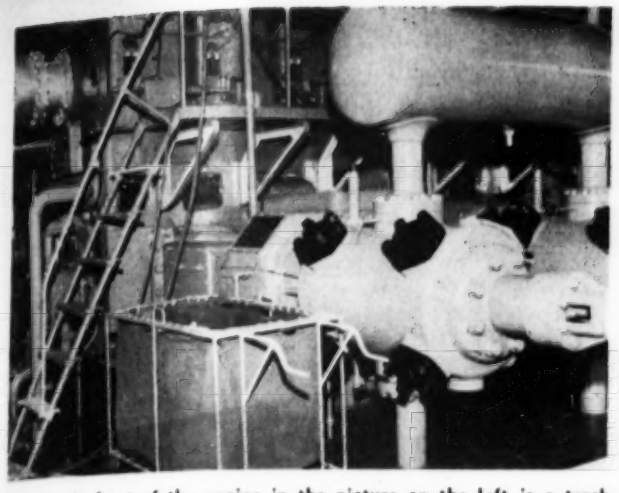
(11) A percentage of the compressors



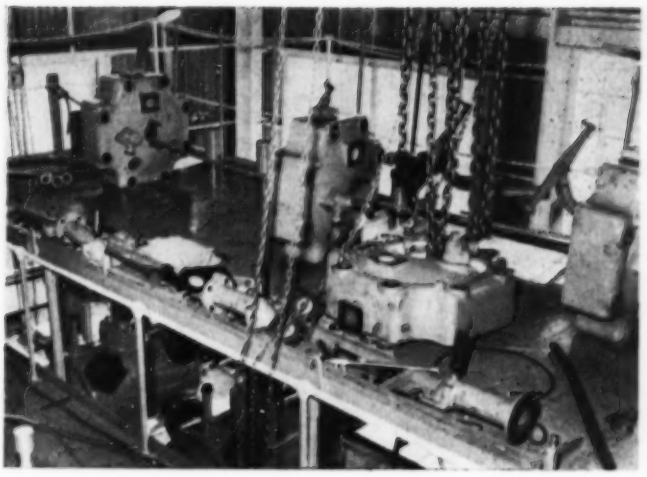
Another step preliminary to overhaul is the setting up of racks for precision instruments used for measuring wear, like those pictured above. Outside the window on the left is an intake air filter and on the right is an exhaust muffler.



Power piston ring rack (left) holds rings that have been removed from the piston and cleaned. "A" frame lifts pistons. Tool board at back.



Standing in front of the engine in the picture on the left is a trash cart that is used to dispose of old gasket material and carbon that has been removed from scavenging system ports and ring grooves.



Barely visible atop the suction gas bottle is a platform used for storing engine parts and tools. At right is the storage platform on which four power cylinder heads are being examined.

are dismantled; measurements are taken on the pistons, cylinders and rods. Rings, packing, clearings and alignment are checked and replaced where necessary.

(12) Other necessary work, such as inspecting and tightening foundation bolts, cleaning crankcases, etc., is accomplished where necessary.

Overhaul work at the three steam stations varies considerably between stations, since the installations are not identical. However, the general nature of the work is as follows:

(1) The boiler tubes, drums and furnaces are inspected, cleaned and repaired where necessary.

(2) Safety valves are inspected.

(3) The boilers, fans, water columns, etc., are checked.

(4) Covers from the turbines are removed for inspection of the rotors.

(5) All bearing clearances are checked.

(6) Rotors, diaphragms and steam nozzles are cleaned of light scale deposits where necessary.

(7) Surface condensers are inspected and cleaned.

(8) Various shaft seals are inspected and replaced if necessary.

(9) All automatic controls are inspected and reworked if necessary.

One of the great advantages in the handling of the running maintenance and annual overhaul on the basis that Transcontinental has applied is that it permits closer coordination and control of the actual work that is done. Also, scheduling downtime results in minimum losses to the overall operation because definitive plans can be made in advance from the gas control standpoint.

Transcontinental has 19 compressor stations, approximately 90 miles apart, starting in the Rio Grande Valley and ending in the suburbs of Philadelphia. There are a total of 115 units with 260,000 installed horsepower. Following the plan that has been outlined above, this company has completely overhauled all of the units in a total of 15 24-hour days.

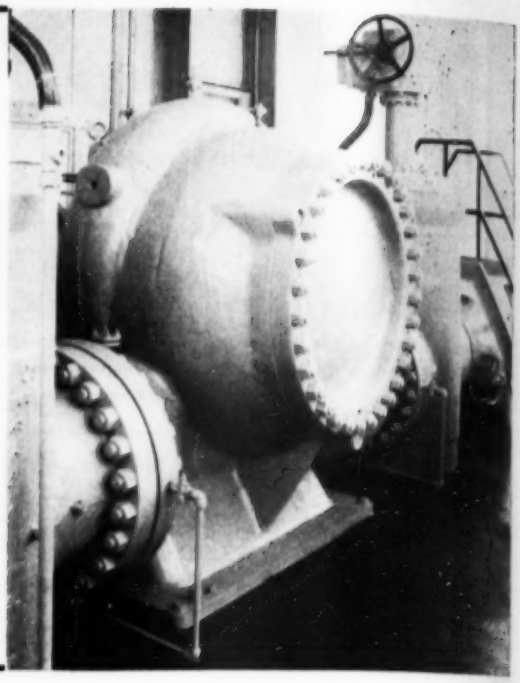
After the overhaul is finished, a complete report on the materials used and the labor expended is made on each unit. This, coupled with the monthly running maintenance analysis, is channelled finally into the general office where all information is correlated for future reference. It is believed that now with the three overhauls passed, it will be possible to predict with considerable accuracy the maintenance requirements for the current year.

One of the outstanding factors noted in connection with the overhaul program is the attendance to detail given by the workmen in connection with the physical work. Provisions are made for and plans include keeping the work area clean and in an orderly manner. This results in a high efficiency and an outstanding safety record. In the year 1954 no loss of time because of accidents occurred during this 15-day overhaul period. There were 19 minor injuries, an average of one per station.

Since the beginning of operation in the winter of 1950-51, overhauls as discussed have been performed three times. After studying the system's downtime figures and comparing these figures with those of similar systems, Transcontinental's management is now thoroughly convinced that its approach to the overhaul problem is most practical in achieving peak performance from the engines. It is the company's intent to continue this program in the future. ■

Inspection plates that have been removed from the engine are at left of center. On the right, adjacent to the engine, is a pump for removing oil from the crankcase. On the left is a storage bin for parts that have been removed from engine.

Tips for maintaining centrifugal compressors and gas turbines



THE external surfaces of a centrifugal compressor should be constantly maintained in a clean condition. This should become a routine part of the preventive maintenance program for compressor stations using this type of equipment.

PREVENTIVE MAINTENANCE FOR THE LUBRICATING OIL SYSTEM

The maintenance of the oil system is important with centrifugals just as it is with reciprocators. The oil itself should be free from contaminants and every effort should be made toward this end. Water, dirt, and other impurities will generally find their way into the oil system in spite of the efforts made to prevent their entry. They should be removed from the system by bypassing part of the oil through a purifier that should be piped into the circulating system. Usually, the oil can be maintained in a relatively clean condition by operating the purifier from two to four hours during each shift; however, if considerable sludge or water is removed by this system of operation, the purifier should be operated for longer periods or even continuously.

The unit should be immediately shut down if there is evidence of a large amount of water in the oil system. The oil filters should be completely drained and carefully cleaned at regular intervals as determined by experience at specific installations.

When the compressor is not in service, corrosion is likely to become acute. To prevent this condition and to maintain the unit, oil should be pumped through the oil system for a few minutes each day, and, at the same time, the compressor should be turned over so that the bearing journals and the sealing elements will become lubricated and the rotor will rest in a new position.

MECHANICAL MAINTENANCE

It will be necessary to open the compressor and thoroughly clean some of the internal parts and assemblies at regular intervals. The comparative lack of experience with centrifugal compressors in the gas pipelining industry makes the establishment of maintenance periods for this equipment a matter best decided by the conditions encountered in service.

Some companies using centrifugals have been completely disassembling them on a yearly basis merely to gain information to be utilized in establishing an optimum maintenance schedule and overhaul period.

The inspection and replacement, if necessary, of the inner seal elements is important to efficient operation. The end cover and the impeller have to be removed for this inspection. The inner seals in most compressors are precision parts and the manufacturer usually requests that these assemblies be returned to him for any necessary overhaul or re-work.

In a cleaning and/or inspection program, it may be desirable to inspect the inner seal sub-assembly, remove the rotor-barrel sub-assembly, disassemble the rotor-barrel components, remove the main seal oil pump and drive, and disassemble the main seal oil pump drive.

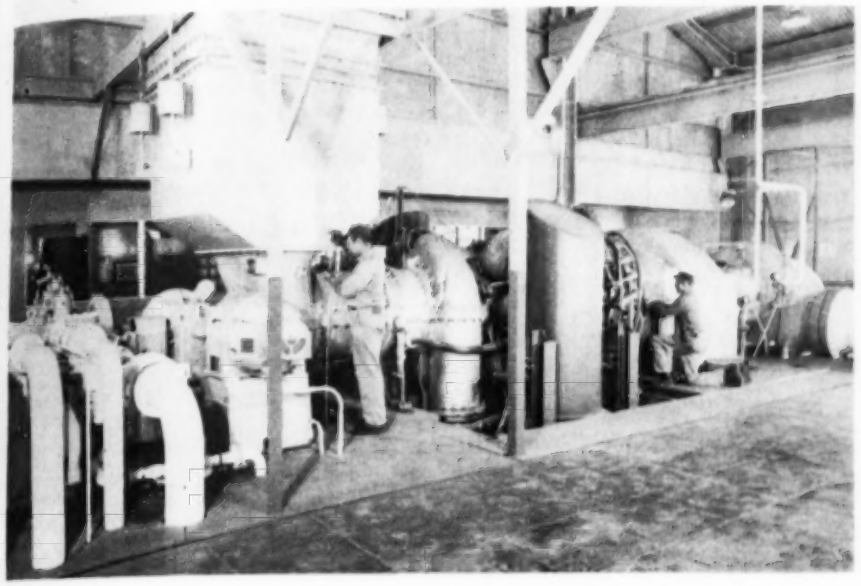
When reassembling, contact surfaces should be checked with Prussian blue to determine that contact areas are sufficient between the mating surfaces. This would apply to seal rings and seal bushings, and seal collars and shaft shoulders, etc.

SUMMARY

A centrifugal compressor does not need to be inspected or checked as often

as a combustion gas turbine or a reciprocator. In fact, it would be difficult to do so because the only way that one of these units can be checked is to completely disassemble it and visaully inspect the components.

Centrifugal compressors are generally checked during a general overhaul. At that time, they may be completely pulled down, and the bearings and seals are checked for wear. The impeller is also checked for wear and balance at this time. The controls on the oil seal system should be checked.



Combustion gas turbine maintenance

Gas transmission companies have not had the many years of operating experience with these prime power units that would be required to formulate definite preventive maintenance and overhaul programs. These are in the process of development and should be thought of as fluid at this time. Undoubtedly, many of the recommendations that have resulted from experience to date will be carried over into long-range policies when operating experience proves them out; too, some of the points recommended for proper maintenance today will be ruled out over the years.

Several of the companies operating with combustion gas turbines have overhauled several of their units to experimentally determine their condition and expected period between planned overhauls. They have been well satisfied with the type of "life" they are getting out of most of the components.

Preventive maintenance check points

The following check points seem to be valid basis for the development of a preventive maintenance program for gas turbines:

Fuel regulators

This part should be checked periodically to ascertain that it is free from any binding or sticking. Also, it has been determined that the fuel control valve and the pressure ratio valve may need to be taken apart and the O-rings replaced to assure a proper oil seal.

Combustion

Combustion can be checked while the machine is running. The spread in the exhaust temperature readings should be carefully observed. If a difference of over 250° F exists between any two thermocouples, check the high or low-reading thermocouple and thermocouple wiring. If the part and the wiring appear to be in good condition, check for flameout in one of the combustors. A flameout condition usually results in smoke in the exhaust gas and an abnormally high VCO pressure. It is well to make this check daily.

Gears

Listening to the gear sets during running time can reveal trouble as reflected by any unusual noise. These checks can be made about every 750 hours or oftener. This check can be applied to the accessory drive gear and the right-angle gear (starting assembly).

Hydraulic cylinders

If the hydraulic cylinders are checked weekly (150 hr) for oil leaks, and the chevron packing is tightened if necessary at a similar interval, some trouble may be averted.

Lubricating oil, gas, cooling water, and air piping

The lube oil and cooling water lines should be visually inspected for possible leaks daily (20 hr). The air and gas piping should be given the same inspection weekly (150 hr).

Lubricating oil tank level

The lube oil level in the tank should be checked weekly. This is particularly important in the case of machines that run continuously.

Fusible plug in the air system

Check the pressure gauge at each fusible plug in the air system weekly. If the pressure is low, remove the plug and check for possible leakage. If leakage is observed, the fusible plug should be replaced.

Nozzle control rheostat

The nozzle operation should be observed for proper response weekly. The rack-and-gear assembly should be checked carefully for freedom of movement.

Lubricating oil pH number

A periodic check of the "acid number" of the lubricating oil is recommended after each 2000 hours of operation. The manufacturer's recommendations should, of course, be followed, and the oil vendor should be consulted if the oil's acid number needs correction.

Starting turbine

The starting turbine should be checked occasionally to determine that it is producing its designed performance and to make sure that its clutch engagement mechanism is operating satisfactorily.

Turbine efficiency

The over-all efficiency of the machine should be checked, using a method for calculating the efficiencies of the various components. If any of the components' efficiencies are lower than their

Compressor maintenance . . . Visually inspect all weld attachments

designed performance, they should be immediately disassembled and inspected for any kind of wear and/or scale build-up. The cleanliness of the axial-flow compressor should be specifically checked.

THE OVERHAUL PROGRAM

Equipment that should be checked when the units are shut down for general overhaul, are as follows:

Air washer

Scale build-up can be a problem with this device. The washer should be checked for scale deposits, and the condition of the filter pads can be visually inspected for separation at the same time.

Axial-flow compressor

The rotor and stator blades should be exposed for inspection by lifting the top halves of the compressor casing. Carefully inspect the previously mentioned internal parts for blade deposits, erosion, pitting, thinning of trailing edges, and rounding off of both leading and trailing tip corners. If any of these conditions are observed, it is well to take photographs (close-ups of the concave and convex sides of the blades) to accompany any written inspection report.

If blade deposits are found, collect two samples in glass bottles and send them to the district service representative of the turbine manufacturer.

If the blades in the top casing halves are observed to be in good condition, it should not be necessary to inspect the blades in the lower halves, but if the lower halves inspection is deemed wise, they can be easily exposed by pushing out the blade mounting rings.

Combustors

(Includes cowl caps, liner sections, transition pieces, and cross-fire tubes.)

Check all component parts for warpage, out-of-roundness, clearances (especially in the cowl cap), corrosion, thinning, and carbon deposits. The manufacturer's district service representative should be appraised of the situation if there are any unusual conditions observed.

First- and second-stage wheels and bucket dovetails

These parts should be red-dye checked for cracks. Wheels should be so checked on both sides. The turbine buckets should also be removed and checked with red dye. Special care should be taken when checking the wheel dovetail slots, the wheel weld, and the bucket dovetails.

Turbine clearance checks

The clearances of the packing, and clearances of bucket tips to shroud, of first- and second-stage wheels, should be checked.

Rotors

If the turbine was observed to run tough prior to the shutdown, check the balance of the rotors. It is well to do this under the supervision of the manufacturer's district service representative.

First-stage nozzle assembly

Observe and record expansion travel of first-stage nozzle as indicated by surface rubs upon disassembly of first-stage nozzle. The first-stage nozzle should be inspected as a unit by removing the halves of the nozzle from their respective turbine shell halves. These two halves should then be placed together to form a ring (this should be done on a flat surface for bolting or clamping). Six diameter checks should be taken as follows:

1. At the joint;
2. At a point 90 deg. away from the joint; and
3. At two intermediate points, making a check every 30° around the circumference.

If unequal distortion has occurred, two measurements should be made at the joint to indicate the difference in width of the two halves.

The insulation rings and the first-stage nozzle outer-insulation-cover-plate should be checked in place for signs of cracking at welds.

Second-stage nozzle assembly

Check the condition of the second-stage nozzle partitions. Look for temperature discoloration, fits, and possible galling. Then, disassemble six second-stage nozzle partitions and inspect O-ring seals, bearing fits, and journals. Take out the corresponding three outer shroud segments and inspect fits and motions. The inner shroud ring can be visually checked for rubs, crushes, and general appearance. If the six nozzle partitions don't show up too well, it may be necessary to take out all of them.

Visually inspect all weld attachments between partitions and shafts. Red dye-check the six partitions that were removed at the outset.

Second-stage nozzle operating mechanism

The partition levers, links, and bearings should be visually inspected. Also, inspect the control ring, and its mounting rollers and bearings when over hauling this part.

Hydraulic cylinders

The two hydraulic cylinders should be disconnected from the control ring and the force required to move each piston against the spring should be measured. In most machines currently on the line, the spring gradient is approximately 140 lb per inch of deflection. Also, measure the force required to turn the nozzle partitions in each direction.

Then, open up one hydraulic cylinder and check for evidence of galling.

Inner diaphragm

Inspect the fit between the radial support pins and the second-stage inner diaphragm. Then, check the upstream and downstream diameters of the inner diffuser-passage wall between stages with a micrometer run for out-of-roundness.

Flexible couplings

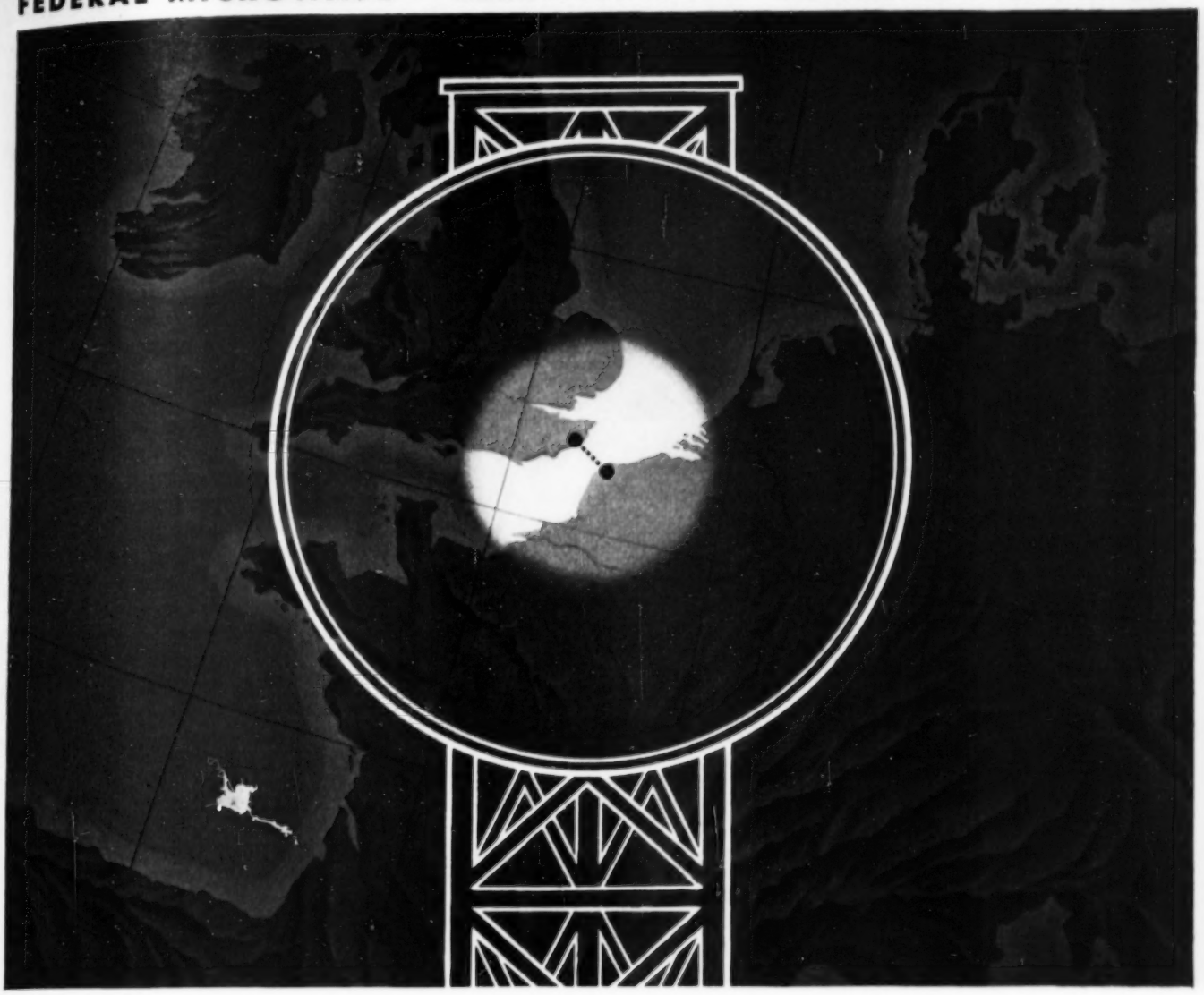
The flexible couplings at the load turbine and the axial-flow compressor should be checked for tooth wear, galling, and fretting. It is recommended that an alignment check be made.

Main bearings

The general condition of all bearings should be inspected and irregularities noted. Look for bad scratches, loose babbitt, high spots, etc.

The three-lobe bearings should be checked for size. To do this, it is recommended that a set of ground shims be made for each of the required bearing sizes. The correct size shims should then be inserted between adjacent lobes.

FEDERAL MICROWAVE—"CERTIFIED BY A WORLD OF RESEARCH"



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Compressor maintenance... Watch for evidence of oil leakage into the turbine

With the shims properly installed, the bearing can be clamped with a band clamp and the diameters checked at various points.

A difference of 0.001 in. in the cylindrical bore diameter will give about 0.0005-in. difference in the three-point diameter of the three-lobe bearing.

The tapered-land thrust bearings should be checked for thickness on the flat section of the thrust shoes, and for taper on the lands. When making the thickness measurement, special care should be exercised to avoid the tapered section. The taper can be checked by first setting the thrust bearing on a surface plate. With a dial indicator referenced to the surface plate and zeroed on one corner of a land, the remaining three corners should be indicated and recorded.

The No. 5 thrust bearing should be bump-checked for thrust clearance before disassembly. The clearance should be recorded. During disassembly, the No. 2 thrust bearing should be bump-checked also. This should be done after the compressor is separated from the turbine, but before the compressor discharge casing has been removed.

It is good practice to check all bearing housings and casing joints for leaks, warpage, and gouges.

Bearing oil deflectors and packing

Carefully check all oil deflectors and packing teeth for oil, dirt, uneven wear, and broken seals. Measure the clearances.

Exhaust temperature units

The bellows and tubes in the exhaust units, including their supports, should be checked for general good mechanical condition.

Tachometer and governor generator

Measure the insulation resistance at the generator terminals by use of a megger.

Overspeed trips

Examine the surface of triggers and bolts for cracks. This can be done with recognized suitable magnetic or chemical flaw test.

System-general

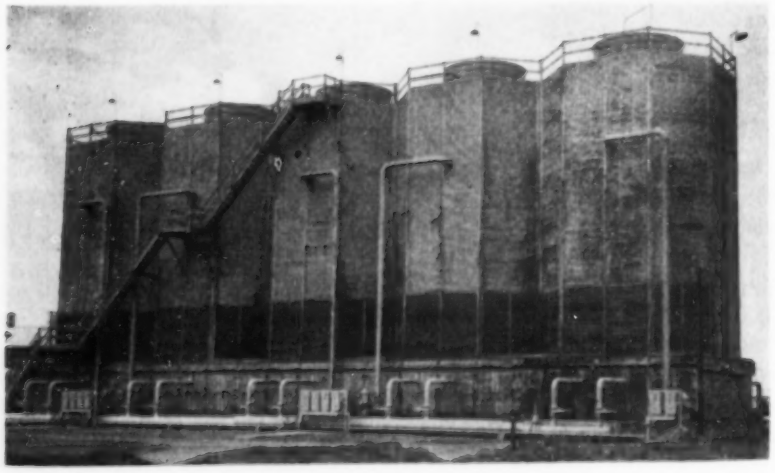
The cooling water system should be flushed and, if necessary, cleaned. For the closed turbine water systems, clean thoroughly and replace the water and inhibitor in accordance with the manufacturer's instructions.

In general, when the overhaul is being made, a careful watch should be kept for any evidence of oil leakage into the turbine. These provisions are good basic practice for maintenance on a combustion gas turbine, but they are not necessarily the ultimate in completeness. The operating company should use this as a guide for the formation of its specific overhaul program that will, undoubtedly, contain many more particular check points or tests that it may deem necessary for a complete job.

Cooling unit maintenance

THE CIRCULATING WATER

THE condition of the water that is circulated through a cooling unit will be of utmost importance in the maintenance of station cooling equipment. The water will not have the same properties or require the same treatment at any two plants, so a competent water treatment consultant or someone from the company's chemical department should be consulted for proper treatment methods. Basically, water should be treated to prevent or control scale formation, the growth of algae, delignification of wood, and to protect any cooling coils, transfer pipes, and other metallic parts in the cooling system.



Large, conventional wooden-decking type cooling towers should be inspected frequently and cleaned as required. Too much water, too little water, and nozzle condition can affect efficiency delivered.

EVAPORATIVE WATER COOLING TOWERS

Water distribution is important to the efficient operation of the more conventional, wooden-decking type cooling tower. Briefly, there are three reasons why distribution of the water fails at times. These are: (1) too much water, (2) too little water, and (3) dirty or clogged spray nozzles. To prevent the first two conditions, the inlet valves (to the pump or pumps) should be operated until they are set to allow flow of the designed volume of water per unit time in the circulating system. Too much water being circulated can produce an adverse effect in the outlet water temperature just as readily as too little water can. Clogged or dirty nozzles are the result of infrequent inspection or no inspection. The preventive maintenance for this condition is obvious.

Tower decking

The decking (wood fill) of a tower should receive frequent inspection. The results of both chemical and biological attack on wood can be visually observed

with ease, so the inspections should reveal when trouble is developing. Chemical attack on the wood in a cooling tower is usually the result of a build-up in the concentration of sodium carbonates or sodium bicarbonates salts through cycles of concentration. Several factors are involved in the chemical attack on wood; they are—the total alkalinity, the pH value of the water, and the dissolved solids content. The pH value cannot be used as the sole control factor because total alkalinity must be controlled to a reasonable level, but the ideal pH level has been found to be about 6.5 for prevention of attack.

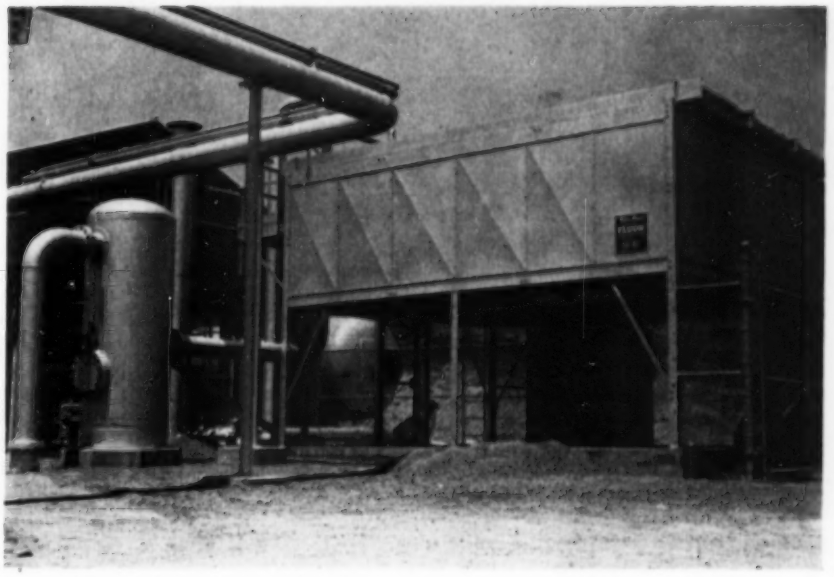
Crystallization of salts

High concentrations of dissolved solids in circulating water can cause trouble where wooden surfaces are subjected to alternate wetting and drying. The neutral salts do not possess marked tendencies to attack the wood chemically, but crystallization of these salts in wetted and dried areas may mechanically ruptured wood cells.

Aside from water treatment and conditioning, hosing down of the wooden decking has proven to be extremely effective preventive maintenance. This method will generally remove deposits of crystallized solids and aid greatly in preventing chemical attack. If this does not do the job of lowering the solids content sufficiently, additional blowdown will be necessary.

Recently, the fact has been recognized that considerable amounts of cooling tower lumber have deteriorated because of biological attack. This attack is the result of the presence of microorganisms that utilize the wood for food. Chemical attack lowers the resistance of the wood to biological attack. so the problem is greatly minimized if steps are taken to eliminate or control chemical attack. Should biological attack occur, and it is demonstrated that this attack is not the result of chemical action, a mycological examination is in order.

About the only proven preventive maintenance for biological attack is periodic inspection and immediate replacement of lumber that is infected. There is considerable research work being done in the application of wood preservatives to cooling tower lumber; however, considerable time will be required to properly evaluate the performance of the preservatives.



Foreign materials on the fins of units such as these Fluor Fin-Fans should be removed during a periodic maintenance plan.

In any case, preventive maintenance for wood decking calls for keeping the decks clean. Dirty or oily surfaces result in increased water losses and reduced efficiency. Steam cleaning will generally take care of oily surfaces and a high-pressure water washdown will remove most other foreign materials apt to be found on cooling tower wooden surfaces. Sagging or broken members in the wood fill should be re paired or replaced without delay. All dirt and debris should be removed from wire strainers, traps, water collecting basins, etc.

Mechanical equipment

Electric motors, gas or diesel engines, gas or steam turbines, couplings, drive shafts, gear reducers, fans, and any other mechanical equipment used in mechanical draft towers or atmospheric units should receive periodic inspection and formal maintenance. The manufacturers of this equipment can furnish recommendations and instructions for this work. These units should not be overlooked during station overhauls, etc. Structural members supporting motors and gears, or, for that matter, any structural member in cooling equipment should be checked for wear, effects of vibration, and deterioration.

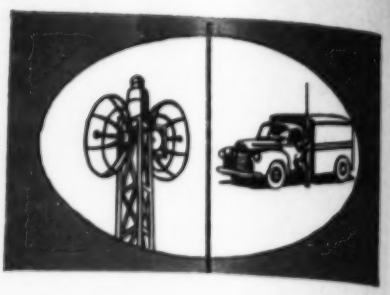
AIR-COOLED UNITS

Small, air-cooled units are likely to be driven by V-belts rather than gears. These should be inspected periodically. The proper tension should be maintained in these drives. If a belt fails, it is usually good policy to replace all of the belts in the set rather than just the one that broke. The location of the units will greatly influence the maintenance program on the finned-tube sections. Vent stacks, smoke stacks, cottonwood trees, and other physical factors will increase the maintenance costs to these installations because of fouling if the previously listed factors are located at close proximity to the cooling device. Naturally, and deposition of solids on the heat exchange areas will reduce the efficiency of the equipment. The fins must be kept straight and clean. Generally speaking, higher temperatures and an increased pressure drop through the unit will indicate excessive fouling. Insects and bugs should be denied access to finned surfaces by the installation of protective screens.

SUMMARY

In summation, cleaning is perhaps the prime operation for maintenance of all cooling equipment. Atmospheric sections have probably caused more trouble and cost operators more to keep clean than other equipment installed in cooling installations. In most cases, this has been because of insufficient water circulation and failure to provide a thorough examination of the effect of water treatment. Preventive and formal maintenance can reduce the expenses involved. Equipment manufacturers will help station personnel work out solutions to cleaning and other problems. ■

communications



By FRANK CHAPMAN

Dry-charged battery soon to be introduced

A DRY-CHARGED storage battery competitive in price with conventional batteries currently on the market is to be released within a matter of weeks by battery manufacturers, according to T. L. Kendall, director of engineering and sales for the Delco-Remy Division, General Motors Corp., speaking before the AGA distribution, motor vehicles and corrosion conference recently in Cincinnati.

Termed by Mr. Kendall as the first major improvement in the storage battery design in the past 20 years—except for the recent change from six to twelve volts—the new dry-charged battery will mean vastly improved performance and life characteristics. Both features are of particular importance in communication service for heavy loads developed in mobile equipment on one hand and highly dependable loads in standby micro-wave repeater equipment on the other.

Shape and size

The new battery will be of approximately the same size and shape as currenty available storage batteries. However, the dry-charged battery contains completely formed positive and negative plates of lead peroxide and sponge lead, respectively, with bone-dry separators. The battery is shipped and stored dry with the acid electrolyte in a separate container. The dry-charged battery is prepared for service simply by adding battery electrolyte. It is ready for service as soon as it can be mounted and connected, within a few minutes after the electrolyte has been added.

The theory behind a dry-charged battery has been known for many years and has been available in premium batteries. However, it is only recently that manufacturing techniques have been developed whereby such a battery may be mass produced and mass distributed.

The dry-charged program described by Mr. Kendall will result in improved battery performance by permitting the stocking of a wide variety of types and sizes without loss due to spoilage of stock, and will eliminate many obvious cost factors in the distribution system, assure a fresh and strong battery for initial service, and make for a realistic product improvement program.

The development of the mass produced dry-charged battery has been held up because of the carefully controlled factory processing required. For one thing, the plates and separators must be free of sulfate or traces of moisture. It is also essential that the separators will be instantly activated under a wide range of conditions. The batteries must be kept dry during storage; and finally, the electrolyte must meet the manufacturers' specifications for purity, specific gravity, and quantity.

Mr. Kendall pointed to the dry-charged battery program as a part of an over-all battery improvement program that will undoubtedly take place over the next five to ten years.

He pointed to the introduction of the 12-volt battery as a step already taken in this direction. Waste space that resulted from adherence to dimensions originally established many years ago when container materials were relatively unsatisfactory and wall sections were very thick was eliminated by the substitution of 12-volt batteries for 6-volt batteries.

With six cells, many possibilities are available for cell arrangement. This fact coupled with more diversified plate dimensions will permit car engineers to adapt battery size and shape to the space requirements of future cars. These better facilities will also permit battery manufacturers to exploit the advantages of much thinner plates and separators, which, with voltage-regulated electrical systems, may be used to gain superior performance characteristics and better power output per unit of volume.

Mr. Kendall also said the industry can expect batteries in all price classes with substantially improved resistance to overcharging to appear on the market in the immediate future, due to important improvements in grid design and grid alloy composition. However, he pointed out that extensive revision of grid manufacturing facilities was necessary to take advantage of known improvements in grid design and composition.

Grid design

Grid design is also a critical factor in the process of undercharging. However, Mr. Kendall pointed out that most grid designs and wire spacings have remained unchanged for 20 years or more. He said that the application of sound engineering principles can and will produce better grid designs for the future—a factor that will also mean extensive modification of plant facilities and tooling.

This entire battery improvement program will, according to Mr. Kendall, cause the storage battery to become no different from any other piece of equipment with a part number. The result would be a substantial reduction in handling and storing costs for the volume user of storage batteries. This, coupled with the improved performance that may be expected from a fresher battery, serves to round out a worthwhile future program.

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Lease-maintenance agreement refused

The California Public Utilities Commission has denied the Pacific Telephone and Telegraph application to take over on a lease and maintenance arrangement the radio-telephone facilities for the combined operation of the Southern California Gas Co. and the Southern Counties Gas Co. The decision was brought down as the result of lengthy hearings that were recently concluded in Los Angeles (see *GAS*, March, p. 168).

In denying the application the commission said that the annual service charge of $114,000 that was agreed upon between the telephone company and the two gas companies was too low. Full cost of the operation, according to commission engineers who testified at the hearings, should amount to about $126,000.

In an interim order, however, the PUC tacitly agreed to approve the deal if the annual charge is raised to $126,000.

The transaction involves purchase by the telephone company of the radio-telephone facilities of the two gas companies for a total of about $358,000, after which the company would maintain the facilities for an annual charge.

Recent FCC allocations

United Fuel Gas Co. for one base station at Hurricane, W. Va., on 33.38 mc.

Southern Union Gas Co. for one base station at El Paso, on 158.31 mc.

Texas Gas Transmission Corp. for two base stations at Eunice, La., on 48.82 mc.

Transcontinental Gas Pipe Line Corp., for 66 operational fixed units, three near Clinton, Le Blanc and Palmetto, La.; Jacksonville, Md.; Beddocks and Tylertown, Miss.; Neshanie, N. J.; Westchester and Oxford, Pa.; Mauriceville and Dayton, Texas; and Middleburg, Va., on 1905 mc; near De Quincy, St. Francisville, and Eunice, La.; Ellicott City, Md., Laurel, Magnolia and Carson, Miss., Tylersport, Pa., Sour Lake, Texas, and Unionville, Va., on 1855 mc.

United Natural Gas Co. for one base station at Driftwood, Pa., on 48.98 mc.

Colorado Interstate Gas Co., for one base station near Amarillo, Texas, on 48.82 mc.

Pacific Gas & Electric Co., for one base station at Randsburg, Calif., on 48.82 mc., with one control unit at Hinkley, Calif., on 456.15 mc. and one relay station at Randsburg on 451.15 mc.

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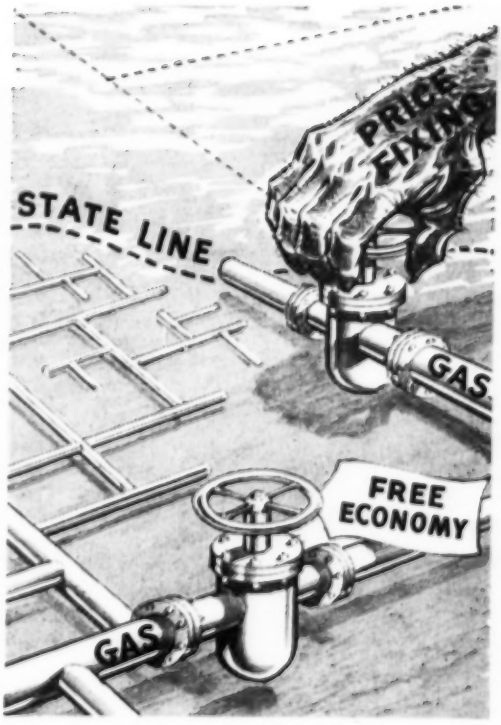

ECONOMISTS of the Empire Trust Company calculated that in the United States, 33,000,000 families cook with gas; 18,000,000 heat water with it; 14,000,000 use it to heat their homes; while 4,000,000 get refrigeration from it. The statistics include all types of gas.

Impressive as they are, they are but an indication of a trend. In the Southwest where it is convenient, 60 per cent of homes use natural gas. In other areas, only 5 per cent of the homes are served with natural gas. The potential is more impressive than the accomplishment.

In just four large cities, 270,000 householders are on lists waiting for natural gas service. This is part of the evidence which justified the prediction that the natural gas industry would have a five-fold expansion between 1950 and 1975. That could be accomplished by providing sufficient transmission systems out of the Southwest, which provides 88 per cent of the nation's natural gas.

The prospect took a different hue when the heavy hand of price fixing came down on the gas producer through the decision of the United States Supreme Court in the Phillips case. Some gas producers immediately cancelled their contracts, which provided for that contingency in the case of federal control. Some state and city officials are now asking the Federal Power Commission to compel continuation of deliveries.

Whatever the outcome of that question, it is certain that some gas producers are not going to make new contracts since, under price fixing, they have no voice in determining the price of their product.

So instead of the home owners of the United States being free to select the fuel they prefer, price fixing by a Government bureau is cutting down the supply of the most efficient fuel—Natural Gas.

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GAS pipeline news

Supreme Court reverses lower court ruling for CIG

Judicial review of FPC rate orders is limited to the points raised by the company involved, the Supreme Court has ruled in reversing a lower court's decision in the Colorado Interstate Gas Co. case. The decision may result in a $4.4 million refund to CIG's customers.

The case involved action taken against an FPC order that $421,537, representing gasoline production expenses, must be excluded from Colorado's cost of service computations for rate-making purposes. The commission excluded the amount as a condition of its 1951 approval of a merger between Colorado and the Canadian River Gas Co. CIG appealed to the 10th Circuit Court of Appeals, which held that the gasoline loss must be added to Colorado's cost of service.

The Supreme Court held that Colorado gave no notice it was attacking the validity of the merger condition and that the Natural Gas Act precludes Court of Appeals review of FPC orders unless the issue had previously been brought to the commission for rehearing.

"It (Colorado) cannot now be allowed to attack an officially approved condition of the merger while retaining at the same time all of its benefits," the court's opinion declared. "The impropriety of the attack is rendered twofold because it is not made in the merger proceeding but is attempted in a separate rate proceeding."

Little Big Inch conversion and 481-mile line okayed

Texas Eastern Transmission Corp.'s $86 million proposal to convert its Little Big Inch gas line to petroleum products and to substitute a gas line have been approved by an FPC presiding examiner.

The company will build a 481-mile 24-in. line from Beaumont, Texas, to connect with its Big Inch line at Kosciusko, Miss. It has been using the 1170-mile line running from Baytown, Texas, to Moundsville, W. Va., to carry gas since it purchased the line from the government after World War II.

Refunds on gathering tax under fire in Texas

A fight is developing over bills to give gas companies credit on present and future tax bills for payments made under the now invalid Texas gathering tax.

One bill, as proposed by Texas Representative Charles Murphy, would benefit those companies that paid the tax without protest and were thus left unprotected when the Supreme Court ruled the tax illegal. Companies that paid the tax under protest have already received refunds.

First in the line of fire was a bill permitting El Paso Natural Gas Co. to sue for around $2 million—the largest single sum involved. A bill permitting Tennessee Natural Gas Co. to sue has already been passed by both houses, signed, and the company has filed suit.

Sen. Dorsey Hardman, who is fighting the bills, said, "these companies weren't without counsel. It's gross negligence on their part. If they'd paid under protest they'd have gotten their money back without suit."

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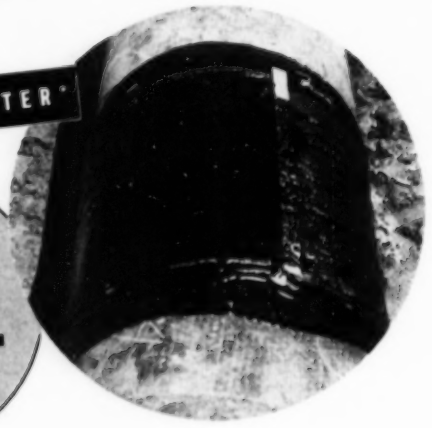

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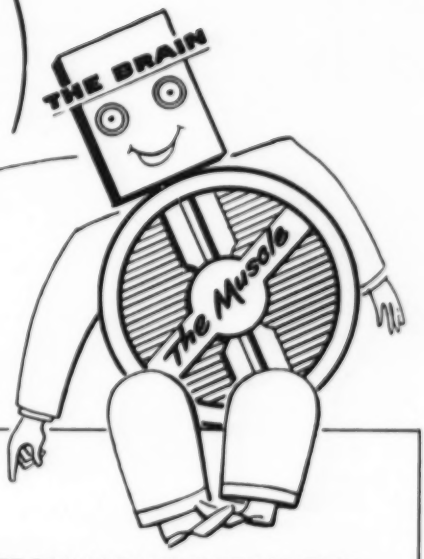

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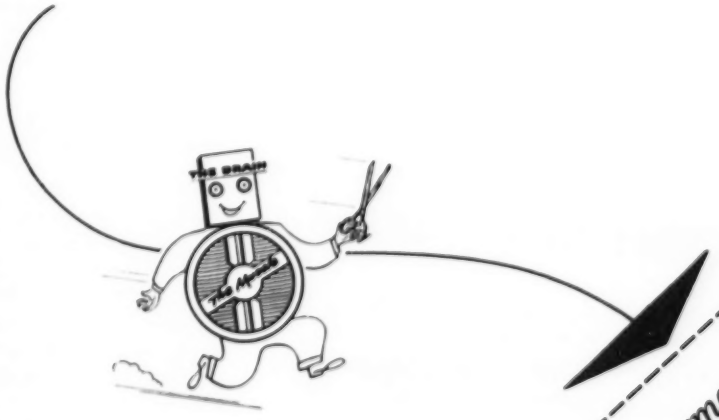

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pipeline news • *Cont'd.*

Montana-Dakota's plan to serve North Dakota off

Hearing before the North Dakota Public Service Commission on Montana-Dakota Utilities Co.'s plan to serve the state was cancelled before it began last month when the company's negotiations to purchase gas from Amerada Petroleum Corp. fell apart.

Although the original plan, which would have consisted of a 500-mile line across the state to serve 30 towns, has been withdrawn, Montana-Dakota is hopeful that an alternate plan consisting of an 80-mile line from Tioga to as far east as Minot, may be completed this year.

Montana-Dakota withdrew its original plan because of a report that indicated gas from the Tioga area would not be adequate for the long line, although Amerada disagrees with this opinion.

Texas' economic waste bill appears doomed

The bill that would permit the Texas Railroad Commission to consider economic waste in setting field rules for gas appears doomed during the current legislative session.

While sponsored and supported by TIPRO and the Panhandle Producers & Royalty Owners Association, the bill was opposed by larger producers, pipelines, utilities, and chemical companies.

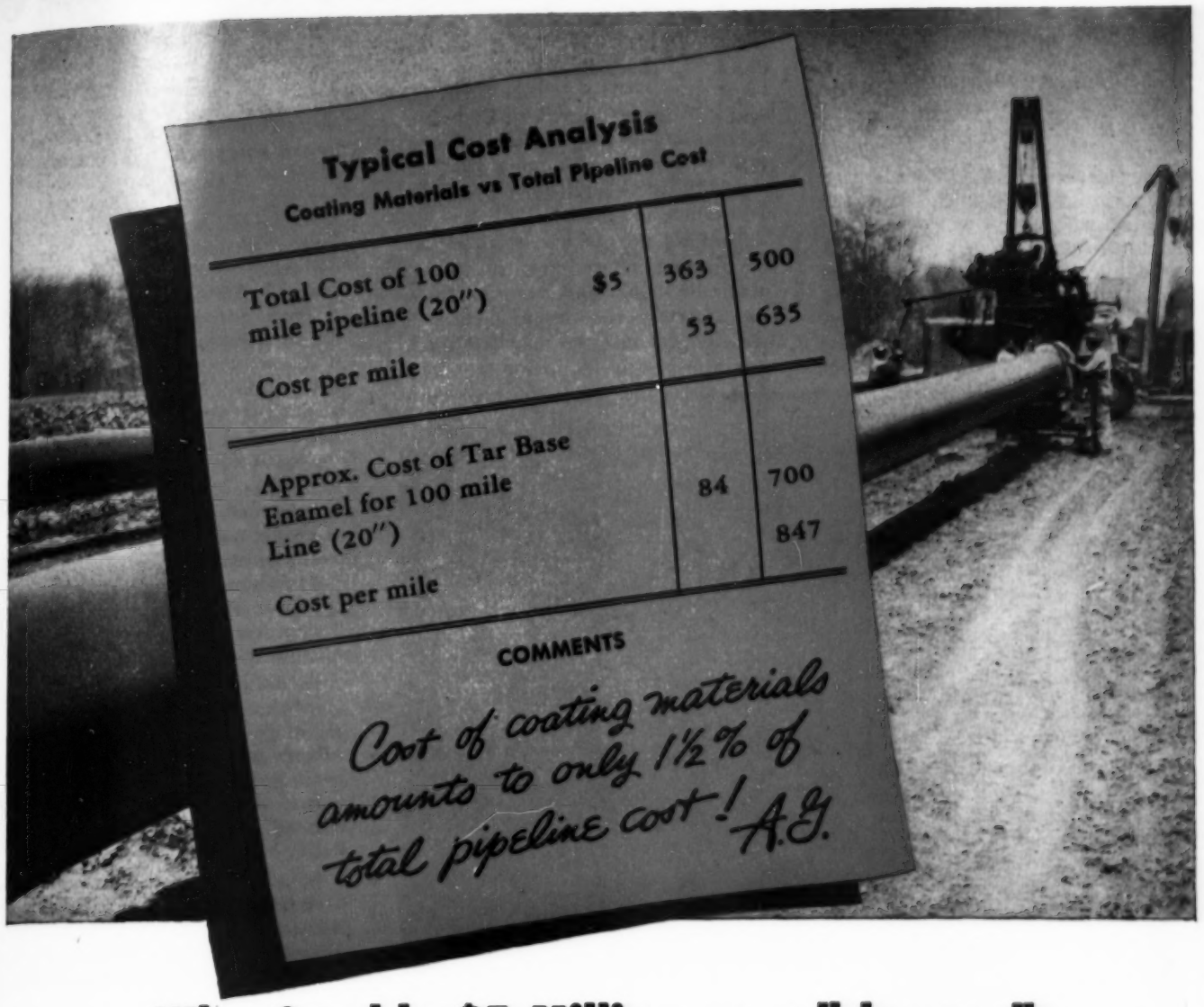
Its major setback occurred when a preliminary vote prevented considering the bill out of order, although it is still rather high on the agenda.

TransCanada's plan postponed for this year

TransCanada Pipe Lines Ltd., will be unable to make a start this year on its all-Canadian pipeline system to bring natural gas to eastern Canada.

The company has always maintained that the 2200-mile line, estimated to cost between $300 and $350 million, could not be undertaken without government guarantee or some other subsidy. Leading stockholders in Trans Canada are men like Clint Murchison of Dallas, Texas, Jules Timins, Canadian gold and iron financier, and Nathan Tanner, former Alberta mines minister.

Numerous plans have been proposed involving various amounts of equity by Trans Canada. The company originally wanted the Canadian government to back bonds to the extent of $250 to $300 million, with Trans Canada maintaining complete control of the project.



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The Canadian government rejected this plan, but suggested that company officials talk to Canada's Industrial Development Bank. Under the plan that developed between TransCanada and the Industrial Development Bank, the Canadian government would have had effective financial as well as legal control of the company, since any action on the part of the banking institution would be secured by the government.

Trans Canada reluctantly accepted this plan in order to get the huge pipeline project under way. The actual scuttling of the plan came from an entirely unexpected source—Gulf Oil and its Canadian subsidiary, Canadian Gulf, which controls the Pincher Creek gas field in Alberta from which TransCanada expects to buy gas. Gulf Oil refused to sell gas as long as there was a possibility of government control over policy and profits.

Banking experts who have studied the pipeline project agree that it is economically sound. They point out, however, that pipe in the ground is poor security and that the only recognized surety in pipeline financing are 20- to 25-year gas purchase contracts of which Trans Canada has few.

Government leaders are enthusiastic about the project because they believe it will offer relief to Canada's growing unemployment problem. However, they are concerned with Trans Canada's suggested equity proportion, which they feel is too small. By backing bonds, they believe Ottawa would be assuming the risk and at the same time enhancing the position of common stockholders in Trans Canada . . . doing both of these things without gaining any effective control of the project. This, of course, would result in a highly explosive political situation. Consequently, the government insisted on a plan that would give the government a measure of control over the project.

The fate of the pipeline rests on a compromise plan that will break the stalemate, and gain the approval of the producers of Alberta gas. Trans Canada also needs more firm contracts with distribution companies, which industry leaders feel will be forthcoming if a suitable compromise is reached.

As the situation now stands, Pacific Northwest Pipeline Corporation is planning to make an offer for southern Alberta gas, even though both the Alberta government and the Canadian federal government have in the past rejected all plans to export gas to the Pacific Northwest.

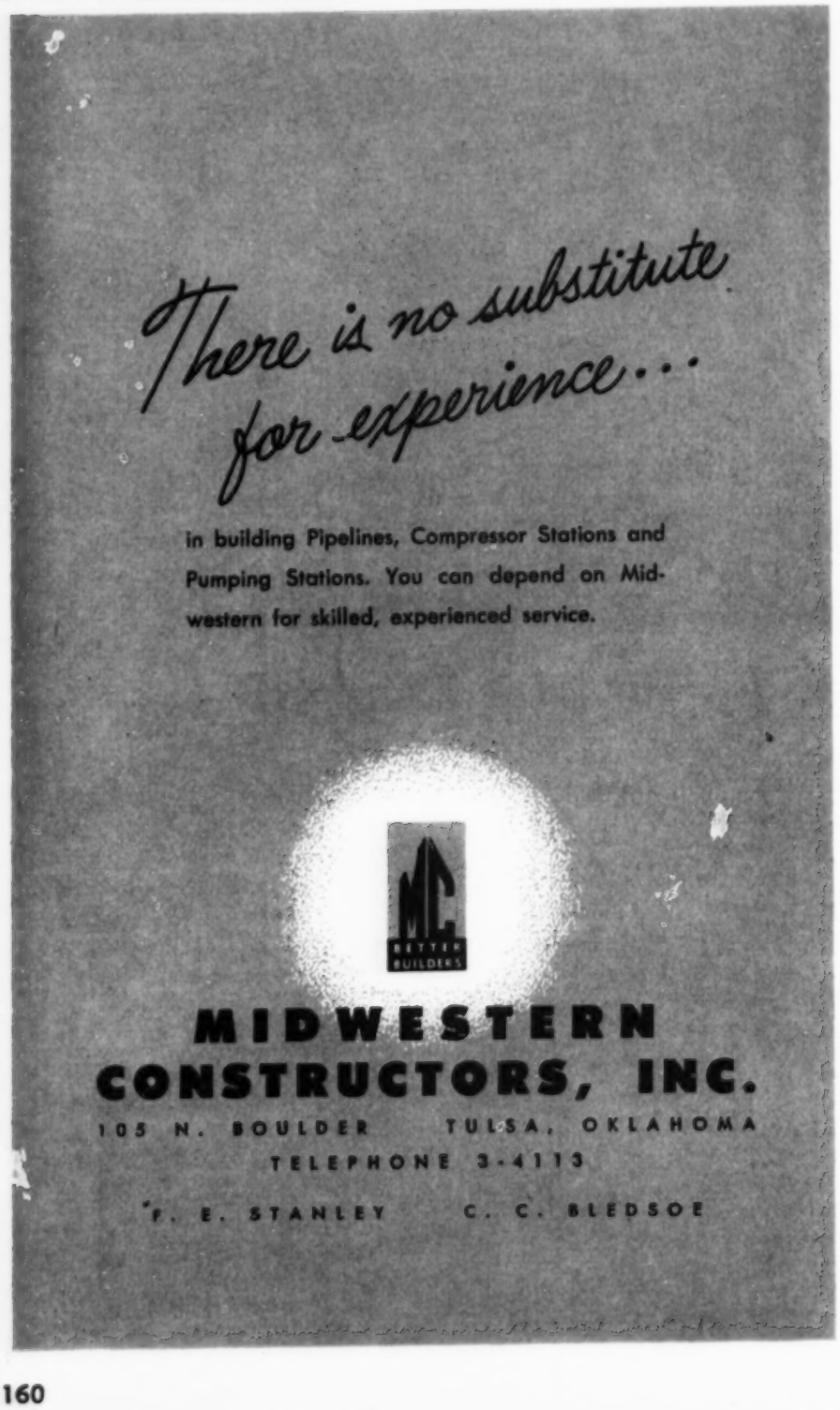
In another action, American firms have reportedly offered to deliver Louisiana gas to eastern Canada for about 33 cents per MMcf, a price much lower than could be met by Trans Canada.

CIG gets FPC okay to reroute pipeline

Colorado Interstate Gas Co., Colorado Springs, has been authorized to reroute a pipeline approved by the FPC lase June 18 (Docket G-2121) for the transportation of natural gas to be received from the proposed transmission system of Pacific Northwest Pipeline Corp.

The changes authorized include the construction of an additional 14 miles of 22-in. pipeline, and a reduction in the authorized compressor horsepower at a proposed compressor station from 5500 hp to 4400 hp.

As now authorized, the line will be relocated to pass near Cheyenne, Wyo., and then south to Colorado Interstate's east Denver control station. Deliveries to Colorado-Wyoming Gas Co. will be made near Cheyenne and at Greeley, Colo. It did not make any estimate of the decrease in the added cost, which previously had been estimated at $848,168—raising the total cost of the project from $23,298,653 to $24,146,821.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C. S. LeNoir

Two new construction companies organized

James P. Neill and C. S. LeNoir, formerly principal owners and operators of Western Pipe Line Constructors Inc., Austin, Texas, have formed two new construction companies following the recent dissolution of this corporation. One of these companies, known as James P. Neill & Company, with James P. Neill as president, will have its offices in Dallas. The other, to be known as C. S. LeNoir & Co., with Mr. LeNoir as president, will be located in Austin.

Both men have for many years been identified with some of the country's major pipeline construction projects. Mr. Neill was formerly with several gas transmission companies as well as Ford, Bacon & Davis; Williams Brothers, and H. C. Price Co. Mr. LeNoir has a background of many years in the construction and operation of transmission pipelines.

George Marsh, formerly a vice president of Western Pipe Line, is to be associated with the joint venture project as project manager.

The two new firms are joining together in the construction of approximately 77 miles of 36-in. loop line in Georgia and South Carolina for Transcontinental Gas Pipe Line Corp.

New facilities sought by United Gas Pipe Line

United Gas Pipe Line Co., Shreveport, has applied to the FPC for authority to spend $8,337,481 to construct approximately 63 miles of pipeline and a new 330-hp compressor station on its system in Mississippi, Alabama, and Florida (Docket G-8230).

The new facilities would enable it to supply increased requirements of existing customers, including Southern Natural Gas Co., Birmingham.

United would also construct facilities at the Jackson, Miss., gas field to test its adaptability for storage purposes. The company would drill 13 wells, construct about 7.3 miles of pipeline, build a dehydration plant, and make adjustment of a 2000-hp unit.

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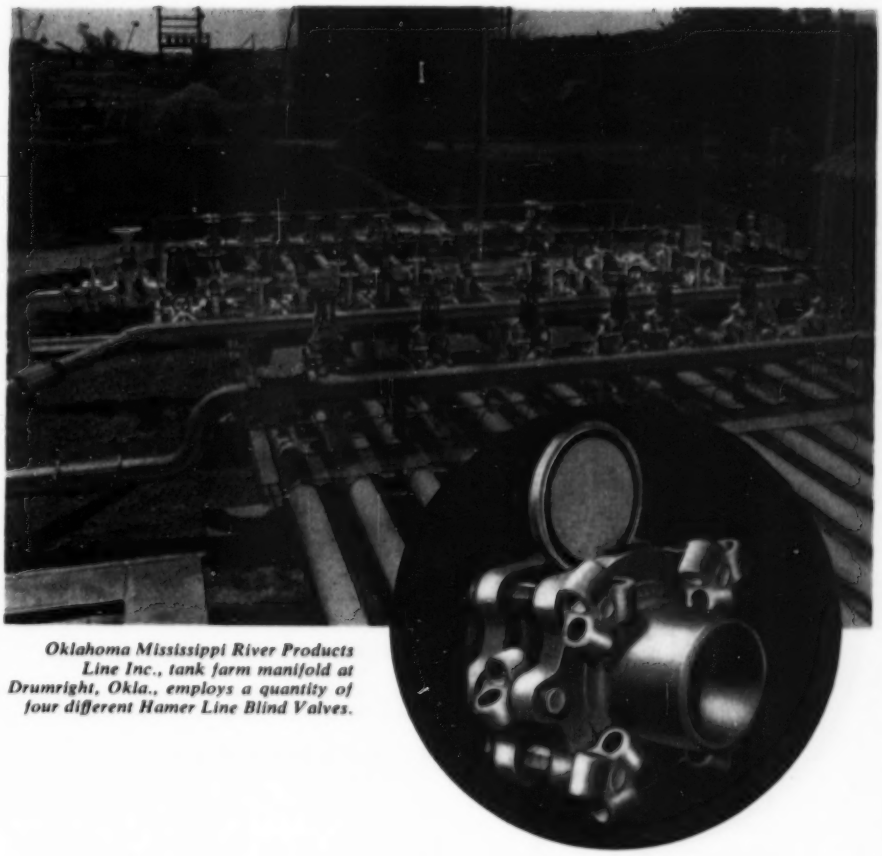

Oklahoma Mississippi River Products Line Inc., tank farm manifold at Drumright, Okla., employs a quantity of four different Hamer Line Blind Valves.

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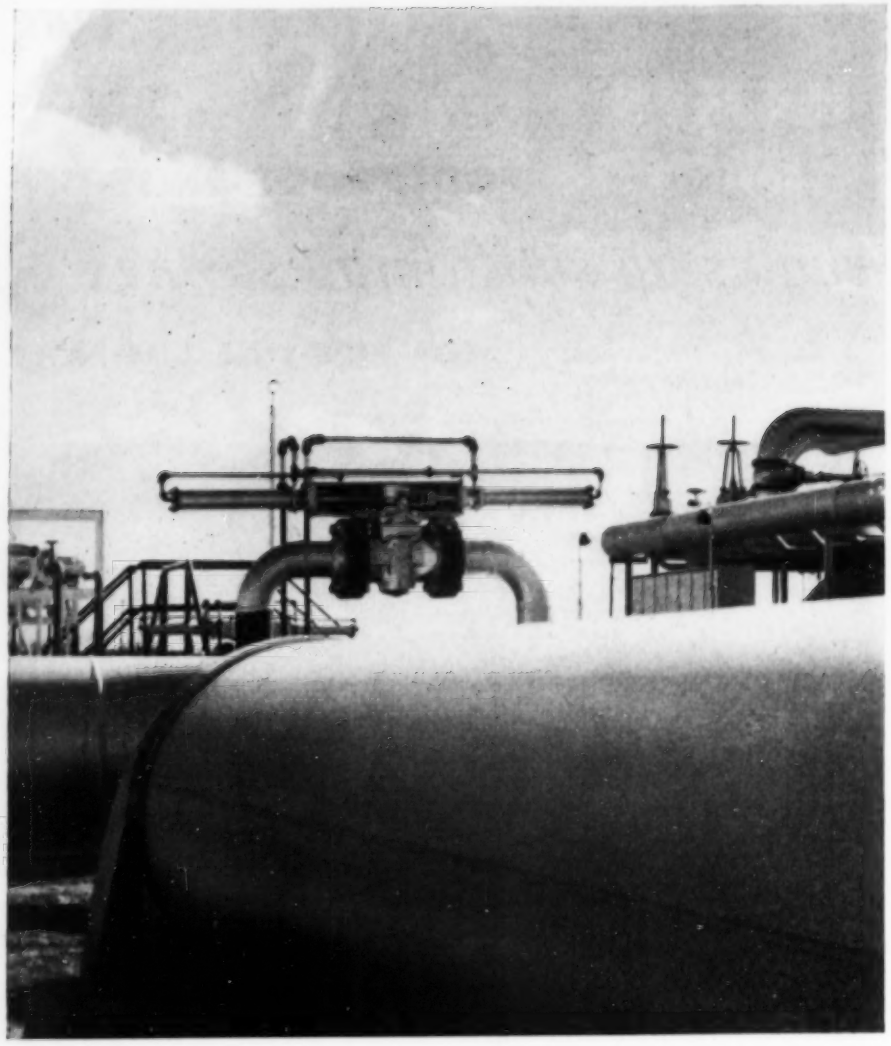
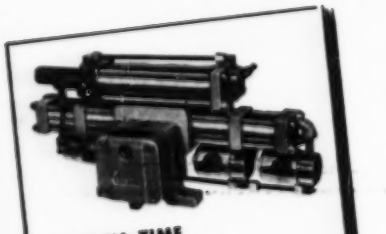


AUTOMATIC BLOWDOWN SYSTEM FOR COMPRESSOR STATION OPERATED BY LEDEEN VALVE ACTUATORS



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When lightning strikes or power fails, this new valve keeps station on line. If power is not restored within adjustable time delay limit set by the valve (2 seconds to 2 minutes), station is blown down and lines vented. Write for data on this compressor station watchdog.

New AGA Code Revision Specifies Emergency Shutdown Facilities...

"Each transmission compressor station shall be provided with an emergency shutdown system by means of which all gas compressing equipment, all gas fires, and all electrical facilities in the vicinity of gas headers and in the compressor building can be shut down and the gas can be blocked out of the station and the station gas piping blown down." (per Paragraph 843.431, Emergency Shutdown Facilities, Revision of Section 8 of ASA B31.1).

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Southern Counties to loop Biggest Inch

Pending approval from the California Public Utilities Commission, the California portion of the Texas Biggest Inch pipeline, which brings natural gas from New Mexico and Texas fields to southern California, is about to become two.

Southern Counties Gas Co. has requested permission from the commission to construct 31.5 miles of 30-in. pipeline between Cactus City and Desert Center in Riverside county.

The $2.5 million project would complete looping of the California-Texas pipeline system all along the 210-mile stretch from the Colorado river to Los Angeles.

Gas from Canada okayed for Montana Power Co.

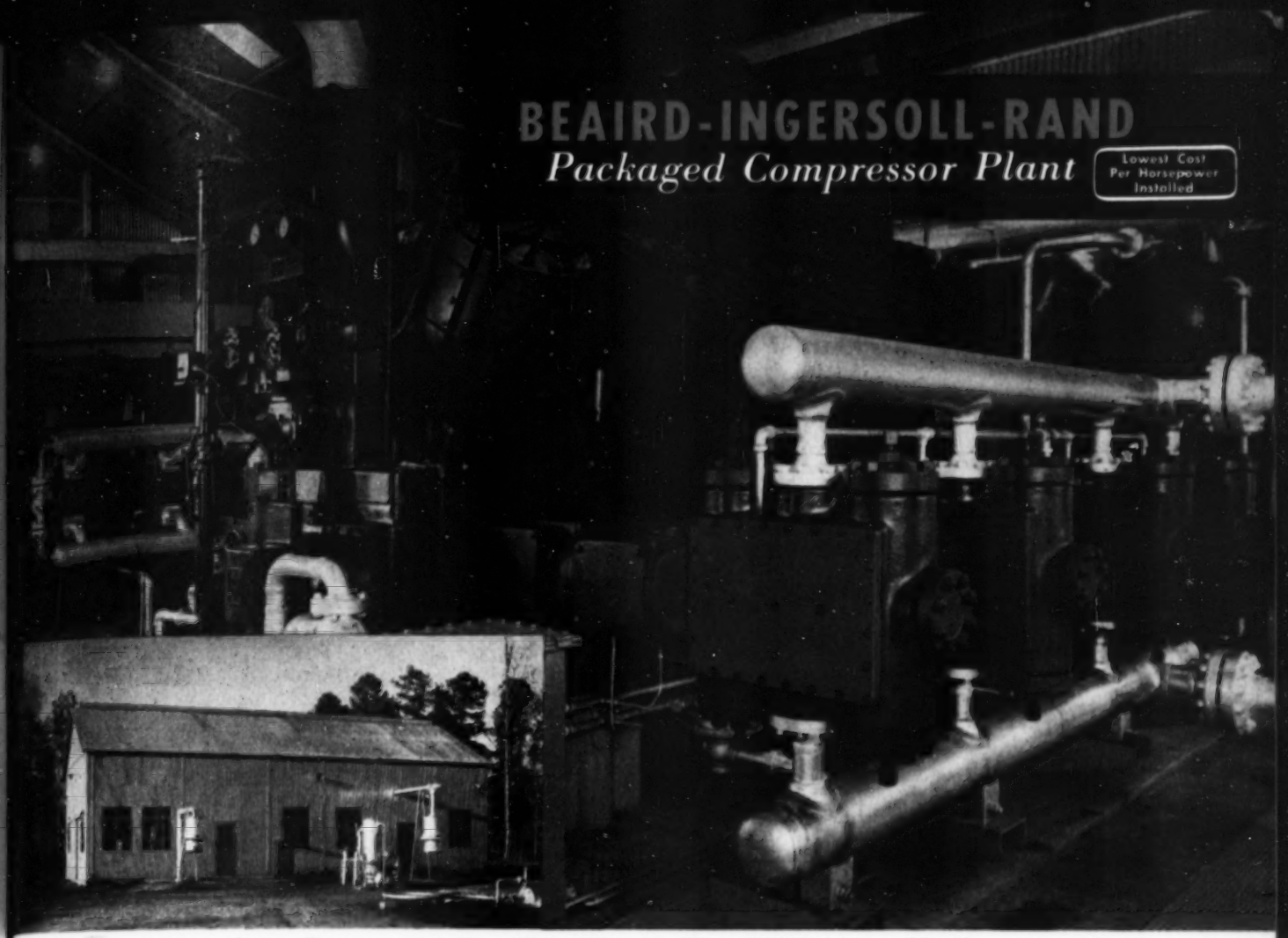
Presiding Examiner Richard N. Ivins of the FPC has filed a decision, subject to review by the commission, authorizing Monana Power Co., Butte, to import from Canada into the United States up to 100 MMcf of natural gas per day, with an annual maximum of 20 billion cu ft. The authorization extends until May 14, 1974 (Docket G—2505 and 2506).

The gas would be imported from the Pakowki Lake area in southeastern Alberta, where it would be produced and gathered by Canadian-Montana Gas Co. Ltd., a subsidiary of Montana Power. It would then be delivered to Canadian-Montana Pipe Line Co., another subsidiary, which would make delivery to Montana Power through existing facilities at a point near Whitlash, Mont., on the U.S.-Canadian boundary.

The FPC in February 1952 authorized Montana Power to import up to 40 MMcf of gas daily and a maximum of 10 billion cu ft annually from Canada, to be used exclusively to render service to the Anaconda Copper Mining Co. That authorization expires April 7, 1956.

The Alberta Petroleum and Natural Gas Conservation Board recently issued a new 20-year permit authorizing the export of a maximum of 100 MMcf per day and up to 20 billion cu ft yearly. An application for an export permit is now pending before the Minister of Trade and Commerce of the Dominion of Canada. Presiding Examiner Ivins conditioned his authorization to require Montana Power to file with the FPC before next Sept. 1 a copy of the necessary authorizations from the Canadian Government.

In authorizing the importation, the



R. Lacy, Inc., Frost Hull Station, Carthage, Texas — equipped with one 440 h.p. 8SVG and one 550 h.p. 10SVG Beaird-Ingersoll-Rand four cycle gas engine driven compressor plants with Young radiators and all necessary controls. Other sizes 110 to 660 h.p.

R. LACY, INC., has planned its Frost Hull station to utilize to the fullest the flexibility of operation possible with packaged compressors. Boosting gas from nearby Carthage, Texas, fields into a sales line, the station was initially equipped with a single 8SVG 440 h.p. Beaird-Ingersoll-Rand packaged compressor plant. The original piping of the installation included connections for the addition of a second packaged unit should wellhead pressures continue to drop off. A year later a 10SVG 550 h.p. Beaird-Ingersoll-Rand packaged compressor was added.

Now operating with single-stage compression, the units pick up gas at 475 psig and boost it to 1,175 psig for delivery to the line. Should wellhead pressures continue to decline, a third unit could be added to the station or the existing units changed over to two stages of compression. Later one of the units could be transferred to other service leaving the remaining plant to complete production. Requiring a minimum in the way of foundation and connecting piping, the entire compressor installation will be almost wholly salvageable when moved.

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pipeline news • *Cont'd.*

Presiding Examiner said that Montana Power is in need of this additional gas for its present and future over-all system requirements. He pointed out that the company has been unsuccessful in its efforts to find any additional gas reserves in Montana or at any other point located within economically feasible distance of its system, except for the Canadian reserves.

Presiding Examiner Ivins dismissed a motion by the competing fuel interveners, consisting of coal and labor interests, to dismiss Montana Power's application, after concluding that the proposed importation is in the public interest. Pointing out that natural gas is a highly valuable natural resource available in limited exhaustible quantities in the United States, he declared that "it seems self-evident that any reasonable augmentation of our limited domestic supplies is desirable unless clearly outweighed by damage to the public interest. No such damage is here shown," he asserted.

Commenting on the coal and labor interveners' contention that the application should be denied in the absence of some intergovernmental agreement between the U.S. and Canada to assure the continuity and adequacy of gas supply, Presiding Examiner Ivins referred to the "amicable relations" which have existed between the two countries for upward of a century, and declared that "in the light of this background of amity and comity between the United States and Canada those applications should be dealt with on their merits."

He also rejected the interveners' argument that Montana Power's application should be disallowed on the basis of the commission's decision issued last June granting a certificate to Pacific Northwest Pipeline Corp. to transport natural gas into the Pacific Northwest area of the United States, and denying competing applications proposing to import natural gas from Canada to serve the same market area. Presiding Examiner Ivins pointed out that the present case does not include any problems connected with construction or financing, and that Montana Power is not wholly dependent upon the proposed Canadian import as a system gas supply. He also noted that Montana Power's operations as a gas public utility are subject to the jurisdiction of the Montana Public Service Commission.

In addition to using the Canadian gas to supply existing markets in Montana, Montana Power also intends to extend service to 11 towns. The company plans to spend an estimated $9,541,119 for the proposed expansion of its system.

• • •

It is reported that the Canadian dominion government may refuse Montana Power's increase in the volume of gas exported. Ottawa is understood to feel that Montana Power seeks to serve the whole area with Canadian gas. Anaconda Copper is the main consumer of the exported gas and it is held the increased gas would supply cheap Canadian energy for products that compete with the base metal mining industr yof British Columbia.

Texas Gas has approval for new construction

Texas Gas Transmission Corp., Owensboro, Ky., has been authorized to construct approximately 207 miles of pipeline and 22,600 hp in compressor capacity on its natural gas transmission system in Louisiana, Mississippi, Tennessee, Kentucky and Indiana (G-6854) at a cost of $17,498,519.

Approximately 90 miles will parallel sections of Texas Gas' existing system. The remainder will constitute a new lateral to serve Indiana Gas and Water Co., Indianapolis, an existing

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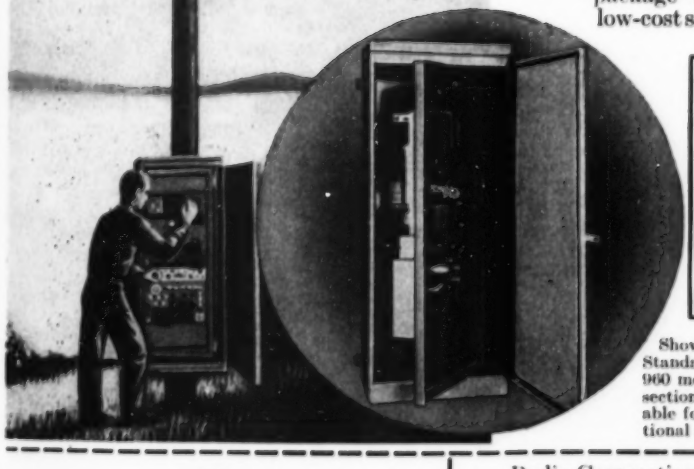
For complete information on the new MM-9 Packaged Microwave Stations, send coupon, below.



Showing hinged rack construction, with all components easily accessible for servicing. Standard "package" equipment includes weather-proof cabinet, 2 parabolic reflectors, 960 megacycle transmitter unit, exciter unit, 960 megacycle receiver. Also 2 100-ft. sections of semi-flexible transmission lines with all required fittings. Space is available for multiplex equipment to provide two voice channels with signaling. Additional multiplex equipment can be mounted in a similar cabinet.

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customer, without the use of any gas from Panhandle Eastern Pipe Line Co. The additional compressor capacity include, 18,100 hp in existing stations and 4500 hp in a new station at Riverton, La.

Part of the new facilities, including about 48 miles of pipeline and 1500 compressor horsepower, were conditionally authorized by the FPC last Oct. 1 as part of another project proposed by Texas Gas, to serve American Louisiana Pipe Line Co. The FPC said that the 48 miles of line and 1500 compressor horsepower of these facilities are now required by Texas Gas to render firm peak day service to its existing customers. However, the commission said, 6600 horsepower in compressor capacity will not be required as part of the new project if service to American Louisiana is not initiated.

FPC rules independents subject to regulation

FPC's chief presiding examiner recently denied three petitions filed by three independent producers of natural gas requesting orders by the FPC declaring that their sales are not subject to regulation under the Natural Gas Act. The decision is subject to review by the commission.

Shell Oil Co., New York; Deep South Oil Co. of Texas, Beaumont, and Humble Oil and Refining Co., Houston, whose sales are made from producing fields in Texas, were the three petitioners. Presiding Examiner Edward Marsh concluded that each of the companies is engaged in the sale in interstate commerce of natural gas for resale, and is therefore a natural gas company within the meaning of the Natural Gas Act.

The case presented for the first time the question of whether a sale of natural gas made before the completion of production and gathering is exempt from the Natural Gas Act by reason of Section 1 (b), which states that the act "shall not apply to the production or gathering of natural gas." The peti-

Cathodic Protection Service recently completed an expansion of its main office building in Houston to accommodate its increased staff of engineers. In addition, the company has constructed a new warehouse shop building adjacent to the office building site to take care of the increased volume of materials handled for both the sales and installation service. E. P. Doremus is president of CPS.

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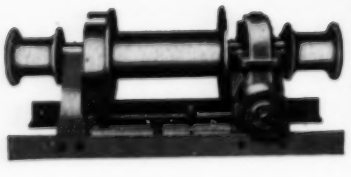

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tioners, while insisting that their sales are not sales in interstate commerce, contend that they are exempt under this provision.

The examiner ruled that the exclusionary provisions apply only to the producing properties and gathering facilities, and does not exempt or exclude the sales of natural gas made during the course of production or gathering or as an incident thereto, whether the sales are made before or after delivery to the interstate pipeline.

The petitioners further contended that the "casinghead" and "gas well" gas that they sell is not the same product processed gas that is resold by the plant operator. They claim that it is not "natural gas" as defined by the act. The presiding examiner ruled out this claim stating that the gas flowed continuously "first with and later without these impurities and other components, through the interconnected pipelines" and across state lines. He concluded that the sale of their gas is a sale in interstate commerce of natural gas for resale within the purview of the Natural Gas Act.

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B.C. Electric signs with Westcoast Transmission

An agreement has been signed between Westcoast Transmission Co. and British Columbia Electric Co. for delivery of Peace river gas for distribution in the lower mainland area of B.C.

Under the agreement, delivery of up to 50 MMcf of gas daily is provided for unconditionally in the initial years. As further proven reserves are acquired by Westcoast, the lower mainland will have the right to share in them with other areas in B.C. before any increase is made in sales to the U.S. This provision gives B.C. Electric a potential addition of 25 MMcf daily.

The two-part pricing formula agreed upon would consist of a commodity charge of 20 cents per Mcf and a peak-demand charge of $3.21 per Mcf.

TGT gets approval for its 370-mile line

The FPC has issued a certificate to Tennessee Gas Transmission Co., Houston, authorizing it to construct a new 30-in. pipeline approximately 370 miles long traversing a gas-gathering area and extending from a point near Agua Dulce, Texas, along the Gulf Coast to the Kinder, La., area (Docket G-8215).

Tennessee will build the new line as a substitution for approximately 211 miles of partial 30-in. mainline loops and 21,240 hp in compressor capacity previously authorized by the FPC but not yet constructed. The proposed 370-mile line will cost an estimated $35,400,000, an increase of $12,400,000 over the cost of the previously authorized but not constructed facilities.

Supreme Court declares Oklahoma price law invalid

Oklahoma's minimum price law is invalid according to a Supreme Court ruling, which states that the state cannot determine the minimum prices of natural gas to be paid by a company that then transports the gas for resale in interstate commerce.

In a 7-to-1 order, the court declared that such transportation and sales are subject to the "exclusive regulation" of the FPC in line with the court's decision handed down last June in the Phillips case. Involved in the case were Natural Gas Pipeline Co. of America vs. Panoma Corp. and the corporation commission of Oklahoma.

Acting in its capacity as the conservation agency of Oklahoma, the commission had set minimum wellhead prices, which allegedly were above some of the minimum contract prices

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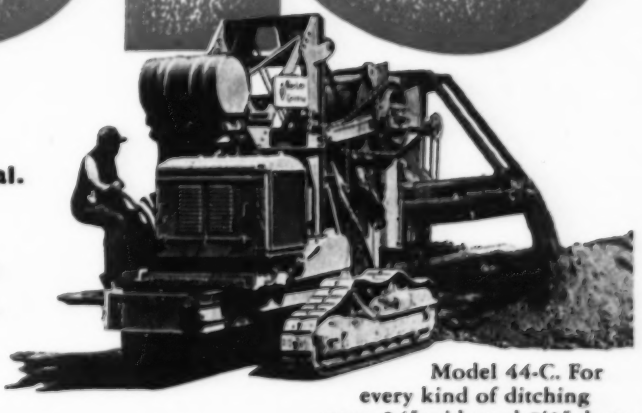

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pipeline news • *Cont'd.*

between producers and the transmission lines. Escalation clauses in the contracts subsequently were set in motion.

In its unsigned order, the court said, Oklahoma had attempted to fix a minimum price for natural gas—after production and gathering are ended—to be paid by an interstate pipeline. But the majority ruled that the Phillips decision "controls" the issue.

The current majority order denied that the Cities Service Gas Co. vs. Peerless Oil & Gas Co., and Phillips Petroleum Co. vs. Oklahoma cases were applicable to the natural gas suit.

The two former cases (in which state minimum pricing had been upheld) dealt with constitutional questions and not the construction of the Natural Gas Act, the order said.

GAS pipeline notes

Five notices filed by Phillips Petroleum Co., Bartlesville, Okla., proposing to cancel rate schedules covering natural gas sales and to terminate deliveries have been rejected by the FPC. The FPC at the same time rejected a notice by Skelly Oil Co. proposing to terminate deliveries to Panhandle Eastern Pipe Line Co., Kansas City, Mo., of the same gas it receives from Phillips. The commission also rejected petitions by Phillips requesting permission to withdraw certificate applications it had filed covering four of the five sales.

The Utah Public Service Commission has been asked to require Utah Natural Gas Co. to transport gas for other companies in its pipeline. Phelps Dodge Corp. and the Kemmerer Coal Co. report that their recently drilled well can be connected to Utah Natural's line for $2500. Utah Natural operates a line from the Clear Creek district in Carbon, Emery and Sanpete counties to a point east of Orem, where the gas is delivered to Mountain Fuel Supply Co.

In recent rate actions, the FPC made effective, subject to refund, Natural Gas Pipeline Co.'s suspended $10,060,000 increase; approved a proposal by Southern Natural Gas Co. to refund a total of $196,366 to its wholesale customers; suspended Olin Transmission Co.'s $1,070,668 increase; and allowed Colorado-Wyoming Gas Co. to put into effect a $777,777 increase.

It is rumored that Pacific Northwest Pipeline Corp., Houston, has arranged to purchase the assets of TransNorthwest Gas Inc., Spokane. TransNorthwest's assets include franchises to build and operate pipelines in eastern Washington and a certificate of public convenience and necessity to serve seven northern Idaho counties with gas.

To eliminate the search through antiquated volumes of the Federal Power Commisison's rules and regulations, a compact, up-to-date compilation of the General Rules and Regulations Under the Natural Gas Act, excluding Subchapter F (Accounts) and G (Approved Forms), which were in force on Jan. 1, 1955, is now available. Information concerning this booklet may be obtained from Robert M. Harris, 3728 Gilbert Dr., Shreveport, La.

The new Pritchard Lo-Line cooling tower, designed for roof-top air conditioning installations where a low silhouette is desirable, was introduced to 35 sales representatives and district office managers at the annual national sales meeting of J. F. Pritchard & Co., manufacturer of industrial and air conditioning cooling towers and air and gas dehydration equipment, in Kansas City, Mo., recently. In addition to the introduction of the new Lo-Line tower, recent improvements in Pritchard industrial cooling towers and Hydryers were presented.

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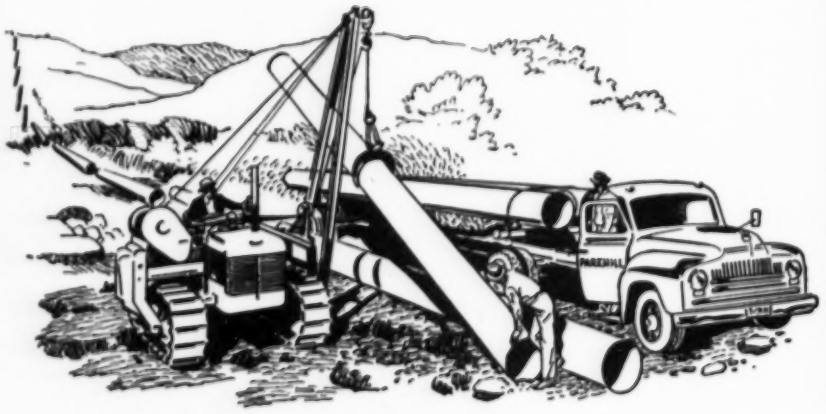

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Phone Liberty 2-5855

Buffalo 2, N. Y.
1508 Liberty Bank Bldg.
Phone Washington 6270

Chicago 2, Illinois
111 W. Washington Street
Phone Franklin 2-5470

Cincinnati 2, Ohio
1302 Carew Tower
Phone Main 1424

Cleveland 13, Ohio
2400 Terminal Tower Bldg.
Phone Main 2605

Columbus 15, Ohio
2850 LeVeque Lincoln Tower
Phone Capitol 4-7211

Dallas 2, Texas
1602 First Nat'l. Bank Bldg.
Phone Randolph 6964

Denver 2, Colorado
814 Continental Oil Bldg.
Phone Main 3-2283

Des Moines 9, Iowa
437 Insurance Exchange Bldg.
Phone 3-5033

Detroit 2, Michigan
926 Fisher Bldg.
Phone Trinity 5-5816

Grand Rapids 2, Michigan
603 Michigan Nat'l. Bank Bldg.
Phone 9-4291

Houston 2, Texas
1350 Esperson Bldg.
Phone Fairfax 1325

Indianapolis 4, Indiana
520 Circle Tower
Phone Melrose 2-3461

Kansas City 6, Mo.
1222 Commerce Bldg.
Phone Victor 5837

Los Angeles 15, Calif.
(Direct communications to Y.S.P. of Calif.)
Phone Prospect 7581

Milwaukee 3, Wisc.
2110 Wisconsin Tower
Phone Marquette 8-5148

Minneapolis 2, Minn.
1050 Baker Bldg.
Phone ATlantic 2970

New Orleans 12, La.
520 Whitney Bldg.
Phone Raymond 0153

New York 36, New York
500 Fifth Avenue
Phone Lackawanna 4-4340

Philadelphia 2, Pa.
1502 Girard Trust Bldg.
Phone Rittenhouse 6-9830

Pittsburgh 22, Pa.
Two Gateway Center
Phone Atlantic 1-2350

St. Louis 3, Mo.
611 Shell Bldg.
Phone Geneva 1223

San Francisco 5, Calif.
55 New Montgomery Street
Phone Garfield 1-6544

Seattle 4, Washington
457 Central Bldg.
Phone Main 6420

Tulsa 3, Oklahoma
1305 Philtower Bldg.
Phone 54-4634

Washington 5, D.C.
327 Bowen Building
Phone Rep. 7-2340

Youngstown 1, Ohio
505 Stambaugh Building
Phone RI 7-0771

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices: Stambaugh Building - - Youngstown 1, Ohio
Plants: Youngstown, Ohio; Struthers, Ohio; Indiana Harbor, Indiana

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - BAR SHAPES - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

GAS pipeline people

In addition to his present duties as vice president and general manager of the government and industrial division, JOSEPH H. GILLIES has been appointed vice president in charge of manufacturing for Philco Corp., Philadelphia.

HOWARD T. SCRANTON, assistant to the vice president of Transcontinental Gas Pipe Line Corp.'s eastern division, has transferred from Newark, N. J., to the comp.ny's office in Decatur, Ga.

W. M. STEPHENS has been appointed acting superintendent of construction for Texas Eastern Transmission Corp., Shreveport. He will supervise communications, compressor station, electrical, materials, and pipeline sections of the company's engineering department.

WILLIAM L. WOLFE has been appointed vice president-sales of Jones & Laughlin Steel Corp.'s supply division in Pittsburgh.

Koppers Co. Inc., Pittsburgh, has formed a company-wide marketing department under the direction of RALPH WINSLOW, vice president. Koppers has also announced the appointment of COOKE BAUSMAN JR., former manager, sales department, as assistant to the general manager of the Chemical division. GEORGE W. NAYLOR has been transferred to that division as manager of the international department. HARRY P. NEHER succeeds him as assistant sales manager of the Tar Products division.

Motorola Inc., Chicago, has named ROY H. OLSON director of engineering in the Communications and electronics division and ROBERT L. BORCHARDT as assistant manager of the technical information center in the same division.

JOHN E. STUCHELL has been named superintendent of New York State Natural Gas Corp.'s newly created Harrison district.

Southern Natural Gas Co., Birmingham, has elected CHARLES C. WHITTELSEY, executive vice president of Ford, Bacon & Davis Inc., and THOMAS M. RITCHIE, vice president of Chase National Bank, as members of the board of directors.

JOHN W. MILLER is now manager of product planning for Kaiser Steel Corp., Oakland, Calif.

JACK D. TOLLIVER has been appointed manager of the recently established sales development division of Tube Turns, Louisville, Ky.

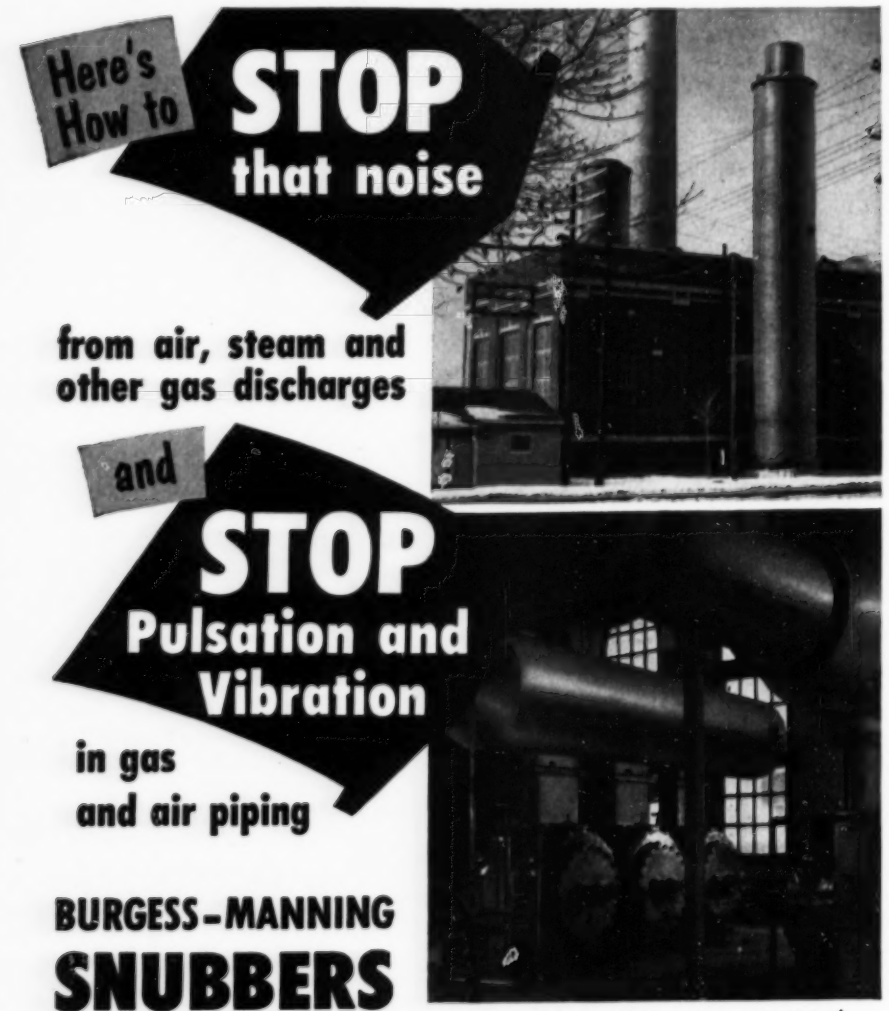
Cooper-Bessemer Corp., Mt. Vernon, Ohio, has elected FLETCHER DEVIN a vice president and has promoted T. M. LAMBERTH JR. to the post of manager of the company's Shreveport branch office.

JOHN CLAYTON JACOBS JR. has been elected a vice president of Texas Eastern Transmission Corp., Shreveport. In addition to assuming new executive duties, he will continue as executive vice president and a director of Wilcox Trend Gathering System.

R. A. MINTER has been promoted to chief engineer of Lone Star Gas Co.'s transmission system.

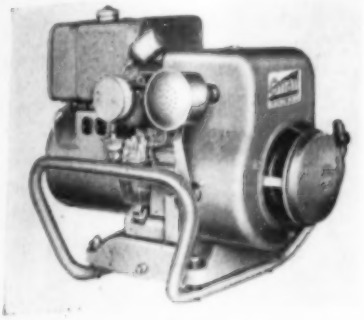
EDWARD D. FLAVIN has been named vice president of the Johns-Manville Sales Corp. and manager of special industries, industrial products division, succeeding L. A. BALDWIN, who has retired.

JAMES E. ALLISON has been appointed director of sales and customer relations for Texas Gas Transmission Corp., Owensboro, Ky.


Here's How to
STOP
that noise
from air, steam and other gas discharges
and
STOP
Pulsation and Vibration
in gas and air piping
BURGESS-MANNING
SNUBBERS
— are engineered to effectively correct your specific noise or pulsation problem.
They are available in many different basic types for arresting intake and exhaust noises, some of which may integrally incorporate such additional features as air cleaning — or heat recovery — or spark arresting — or surge control — or water separating.
Others, which are primarily designed to stop line surges set up by compressors, pumps, blowers, etc., will effect noteworthy savings in piping, repairs and maintenance, and permit accurate flow readings.
There is no obligation for recommendations.
Send us a description of your problem.
BURGESS-MANNING COMPANY
Sound Engineering
717 East Park Avenue, Libertyville, Illinois
Branch Offices: Dallas • Chicago

GAS new pipeline products

(For additional information, use coupon on page 61.)



22 Generating Plants

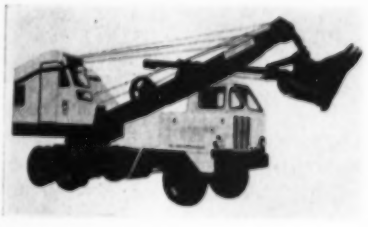
A completely new line of small engine driven electric generating plants ranging in size from 500 to 2500 watts has been announced by D. W. Onan & Sons Inc.

The new models are available in sizes of 500 and 750 watts, 60-cycle, a.c. for the AK series, and in 1000 and 2500 watts, 60-cycle, a.c. in the AJ series.

Because of their small size and high output per pound weight, the new models are highly suitable for mobile and portable applications. Both AK and AJ engines are equipped with rotating Stellite-faced exhaust valves, solid Stellite exhaust inserts, extra-large long-life bearings, radio shielded, high-tension magneto ignition, built-in governor and permanent mesh air-cleaner and oil-dipped pack.

D. W. Onan & Sons Inc.

■



23 Excavator

Dixie crane, new, high-speed, compact excavator in the ⅜-yd, 5- to 6-ton class, has been announced by Dixie Crane & Shovel Co.

Crane, shovel or trench hoe rigs are available on either rubber tired crane carrier or on 20-in. crawlers. A complete line of attachments for dragline, clamshell, magnet, pile driver, grapple or concrete bucket work is offered.

Crane rigged, on rubber tires, the Dixie has a lifting capacity of 6 tons with the standard 25-ft boom at a 10-ft radius. Five and 10-ft boom inserts and a jib can be furnished to supplement the two 12½-ft standard sections.

SERVICED BY THE MEN WHO SELL IT

Another reason why You can depend on

TAPECOAT®

the Coal Tar Protection in Handy Tape Form

The service behind TAPECOAT is as distinctive as this coal tar coating, itself.

To make this service as dependable as the product, the sales engineer who sells the job also services it. This means that you can count on everything he tells you because he is responsible for the job *personally.*

The fact is, TAPECOAT gives you more lasting protection for your money because it is a quality coal tar product, and coal tar is nature's own defense against corrosion.

Specify TAPECOAT for pipe, pipe joints, tanks, and other vulnerable steel surfaces above or below ground. Its performance record since 1941 merits your complete confidence.

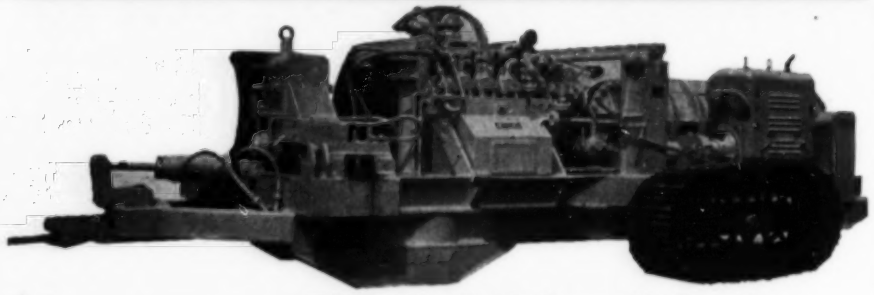
TAPECOAT comes in rolls of 2", 3", 4", 6", 18" and 24" widths. It's easy to apply as our sales engineers will demonstrate.

Write for brochure and prices today.

The* TAPECOAT *Company

Originators of Coal Tar Tape Protection

1535 Lyons Street, Evanston, Illinois



first

With Big Inch Smooth Bends... In Performance!

...The CINCH Pipe Bender

- Features for Greater Speed and Easier Handling:
- Automatic Hydraulic Wedge-Type Pin-Up Slide
- Extra Large Piston Rams and Return Oil Lines
- Hydraulic Lift Tongue and Tulsa Winch
- Atney Tracs (optional)

There's no better method for bending pipe smoothly and evenly than with hydraulically exerted cold compression as provided by The Cinch Bender. Contractors agree that Cinch provides speed, economy, and safe pipe bending right on the job. So—If you're a pipeline owner or contractor desiring top performance, insist on the product which pioneered and continued to improve smooth bending in big inch pipe . . . Cinch!

THE "CINCH PIPE BENDER" MAKES PIPE BENDING A CINCH

7020 LONG DRIVE
HOUSTON 17, TEXAS
Phone Milby 2484

CINCH
PIPELINE EQUIPMENT, Inc.

Maintain

PIPE LINE
RIGHTS-OF-WAY
AT LESS COST

WITH CALDWELL ROTARY CUTTERS

You can keep your pipe line rights-of-way in the clear and spend less money doing it with a Caldwell S-2 Rotary Cutter. This sturdy machine's 57-inch Spring Steel Blade will cut brush two inches thick, and better, in a single once over. Mechanized maintenance with Caldwell Cutters is not only better and cheaper—it's quicker.

Timken Bearings, Blood Bros. Universal, Alemite Fittings, standard P.T.O. Model available for three-point hitch.

Users include Transcontinental, Texas-Illinois Transmission, Tennessee Transmission, Sun Pipe Line, Atlantic, Gulf and others. Write Dept. G for illustrated literature.

E. L. CALDWELL & SONS CORPUS CHRISTI, TEXAS

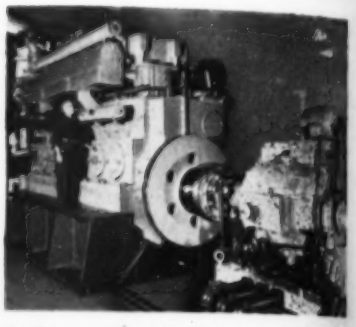
new products • *Cont'd.*

Equipped as a shovel, the Dixie can excavate to a maximum height of 18½ ft and dump at 13 ft. Maximum dumping radius is 19 ft. It can dig at 2½ ft below ground level. The ⅜-yd bucket is equipped with power-operated dipper trip.

When set up for trench hoe operation, a Dixie can cut 13½ ft below ground, yet it has an above ground clearance of over 15 ft at end of dump. The trench hoe can reach out 23½ ft at ground level.

Dixie Crane & Shovel Co.

■



24 Power Engines

Worthington Corp. has produced a new line of power engines that are of a high-pressure, turbo-supercharged, four-cycle design, rated from 1360 to 5000 hp at 450 rpm. Largest of the new SW 14 line is a 16-cylinder V-engine.

The tri-power arrangement permits use of the new engines as oil diesel, dual-fuel diesel, or spark ignition gas.

One of the features built into the new line is interchangeability of major parts between the in-line and the V-engines, such as cylinders, heads, rods, pistons, bearings, fuel injection equipment, etc.

Other major features are: combustion chamber designed to burn more efficiently the large quantities of fuel required for the higher power output; four valves (two inlet and two exhaust) mounted in cylinder head; symmetrical dished piston design, flood cooled for maximum strength and uniform cooling.

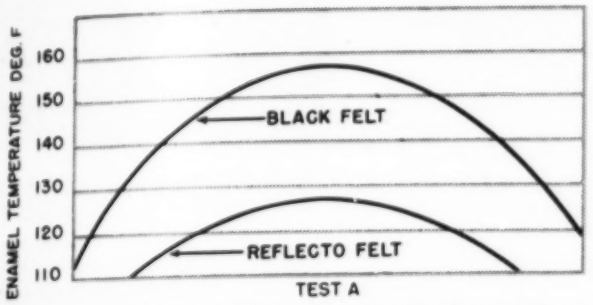
Worthington Corp.

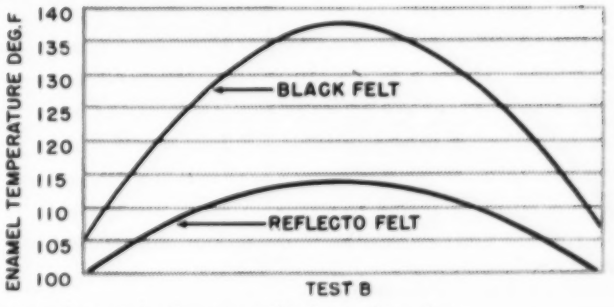
■

25 Mist Collector

Dollinger Corp.'s new Electro-Stay new mist collector for eliminating oil mist and smoke at its source has been designed to be mounted on or near high-speed grinding and cutting machines. The mist collector removes more than 90% of oil mist and smoke and returns clean air to the shop. Completely self-contained, the unit provides

REDUCE TEMPERATURE
of ENAMEL as much as 30°
WITH NICOLET REFLECTO-FELT





Above are the results of studies by an independent research organization upon the heat absorption characteristics of Nicolet Reflecto-Felt (white) vs. black felt.

Under controlled surface heat of 140 degrees, enamel under black felt registered 156 degrees. The enamel under Reflecto-Felt registered 126 degrees . . . A TEMPERATURE REDUCTION OF 30 DEGREES.

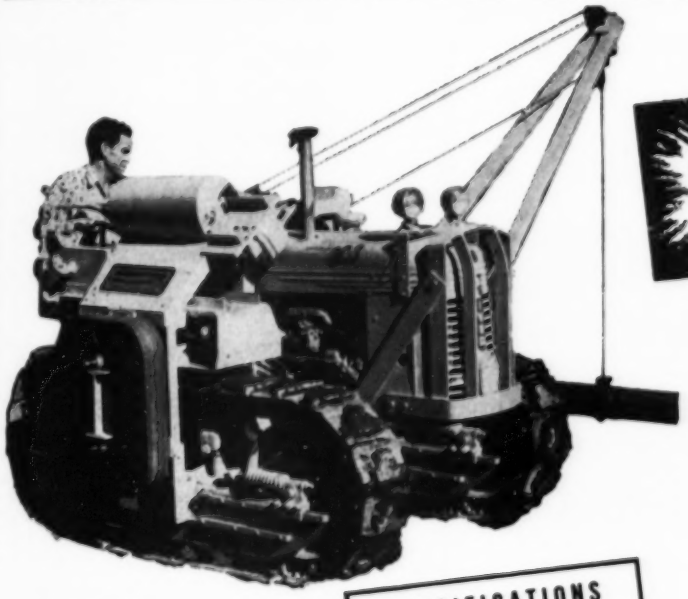
With controlled surface temperature of TEST A reduced 30%, ENAMEL UNDER REFLECTO-FELT REGISTERED 23 DEGREES LESS THAN ENAMEL UNDER BLACK FELT.

WITH REFLECTO-FELT, YARD WRAPPED PIPE CAN NOW BE STORED. ENAMEL SAG IS REDUCED ON PIPE COATED OVER THE DITCH. INVESTIGATE REFLECTO-FELT NOW. WRITE FOR LITERATURE.

The Felt With a Future

MANUFACTURED BY:
NICOLET INDUSTRIES, INC.

70 PINE STREET
NEW YORK 5, N. Y.



THE *Little Boomer*
CUSTOM MANUFACTURED BY MIDWESTERN

It's amazing—a small Oliver OC-3 tractor fitted with a strong, lightweight side-boom. Fully hydraulic, the boom has a lifting capacity from 800 lbs. at a 30° angle to over 1600 lbs. at a 70° angle. The slipping clutch design reduces boom control to *only two!* The small size and light weight (5,250 lbs.) of the Little Boomer makes it extremely maneuverable, and it can be loaded on a medium sized truck for quick and economical transportation. Finally it is priced at approximately one-third the cost of competitive equipment normally used on this type of work. Optional equipment—street pads, tail-end winch.

- LIGHT WEIGHT
- POWERFUL
- MANEUVERABLE
- FLEXIBLE
- ECONOMICAL
- EASY TO OPERATE
- FULLY HYDRAULIC

SPECIFICATIONS

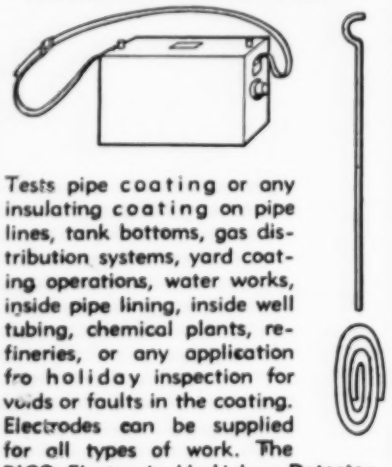
TRACTOR:		
Drawbar Speeds:	Horsepower	21.85
	First MPH	2.81
	Second	3.19
	Third	5.24
	Reverse	2.33
SIDE-BOOM		Standard Winch
Drums		5/16"
Cables		84"
Height		101"
Length		66"
Width		10'
Boom Length		

The "Little Boomer" Is Manufactured By . . .

MIDWESTERN ENGINE & EQUIPMENT CO., INC.

4645 Sapulpa Rd. Tulsa, Oklahoma
15 S. W. 29th St. Oklahoma City, Oklahoma

PICO ELECTRONIC HOLIDAY DETECTORS



Tests pipe coating or any insulating coating on pipe lines, tank bottoms, gas distribution systems, yard coating operations, water works, inside pipe lining, inside well tubing, chemical plants, refineries, or any application fro holiday inspection for voids or faults in the coating. Electrodes can be supplied for all types of work. The PICO Electronic Holiday Detector uses a 6 volt dry battery with an output of 18,000 volts D.C. It is mounted in a Plexiglas housing and weighs 13 lbs. Comes complete with pusher-handle and 7 Foot Electrode Spring. Price $290.00. Line-traveling type slightly higher. Write for literature.

PETROLEUM INSTRUMENT COMPANY
2200 W. ALABAMA • HOUSTON, TEXAS

new products • *Cont'd.*

a packaged ventilating system for individual machine tools.

Oil-laden air is drawn in at the unit base and metal chips and abrasive material are screened. Mist particles are positively charged in the ionizing section of the cell. Negatively charged collector plates then attract and separate oil from the air stream. Clean air continues through. When oil accumulates on the plates in droplets heavy enough to resist the air stream, it drops off the bottom edge, passing through the screen into a reservoir, thus retaining a clean cell and screen.

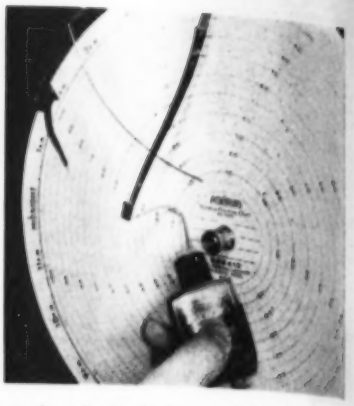
Dollinger Corp.

■

26 Instrument Inker

A new general purpose ink has been developed by the Foxboro Co. for use with the company's complete line of industrial recording instruments. Designated at Type 1500 ink, it was especially formulated for use with Foxboro pens and Humitex charts to produce the sharpest possible record of a process variable.

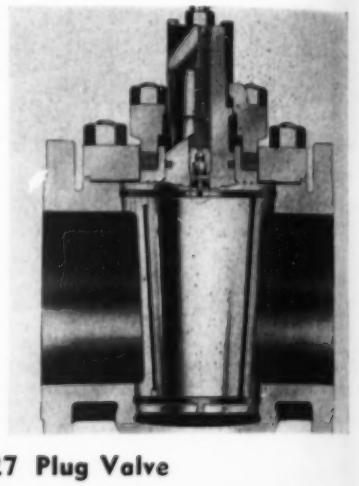
Containing no sediment, the new ink is smooth flowing, will not clog the pen, and dries quickly without feathering the chart. It is rated for high temperature, and can also be used down to 0° F.



For convenience in inking the pen, Type 1500 ink is furnished in a newly designed one-ounce polyethylene squeeze bottle. An exclusive plastic capillary tube and filter assembly enables the user to pinpoint a precise quantity of ink on the pen without dripping it on chart or instrument.

Foxboro Co.

■



27 Plug Valve

Longer life, ease of operation, ease of adjustment and positive pressure-sealing are claimed by the Ohio Injector Co. for its new lubricated plug valve design.

A feature of the valve is multiple sealing, which includes lubricant, "O" ring, gland liner and packing seals.

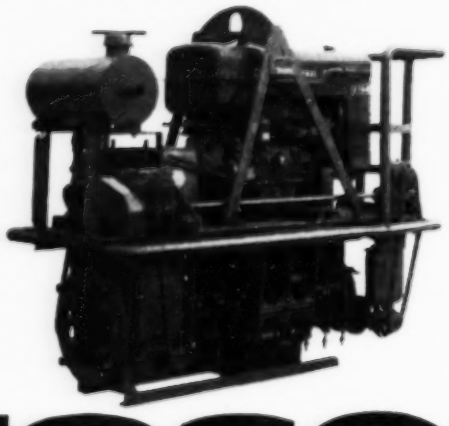
Four vertical lubrication grooves in the plug assure uniform and adequate distribution of a sealing lubricant around the port areas. Two grooves (180° apart) do not cross body ports in operation; two grooves (180° apart) do cross body ports in operation but are connected with lubricant supply only when the plug is in fully opened or closed position.

Precision gland adjustment is achieved by the use of fine thread studs and semi-finished, washer-faced nuts on spot faced bearing surfaces of the gland. A minimum of recurring adjustments is

cleans pipe more efficiently . . . FASTER!

CROSE LINE TRAVELING PIPE CLEANING AND PRIMING MACHINE

This versatile pipe cleaning and priming machine can be used for line traveling operation or with stationary base (shown at right) for yard cleaning and priming—either way it is better built and more efficient to give you faster, trouble-free service. Crose cleaning and priming machines are available for all sizes of pipe including 36"



m.j. Crose MANUFACTURING COMPANY, INC.
2715 DAWSON ROAD • PHONE 6-2172 • TULSA, OKLAHOMA
14693 EAST COLFAX AVENUE, AURORA, COLORADO • 500 FIFTH AVENUE, NEW YORK CITY
DISTRIBUTORS: CROSE-CURRAN LTD., EDMONTON • CROSE PIPELINE EQUIPMENT CO., INC., NEWARK, N. J. • PIPELINE SUPPLY CO., HOUSTON

required because the resilient packing is completely isolated from all moving parts which assures longest possible packing life.

A position indicator on top of the plug shank and a visual stop integral with the gland show the position of the plug at a glance.

Ohio Injector Co.

■

GAS trade literature

28 Thermocouple Bulletin

A new edition of its 56-page bulletin P1238 on thermocouples and pyrometer accessories has been released by the Bristol Co. The bulletin, a buyers guide and users manual, has 165 photos and line drawings illustrating products, suggested installation techniques, etc.

Bristol Co.

■

29 Pump Chart

A chart designed to quickly identify the probable source of failure or erratic performance in most widely used types of rotary displacement pumps is contained in a new pamphlet, "Pump Chart Spots the Trouble." Prepared by Eco Engineering Co., the chart details more than 25 possible mechanical and chemical trouble symptoms.

Eco Engineering Co.

■

30 Converter Catalog

A complete line of Digi-Coder digital converters, electro-mechanical shaft position types, and voltage types are described in Fischer & Porter Catalog 58-10. The 12-page catalog presents operation, characteristics, accuracy, and specifications together with drawings, photographs, and installation diagrams.

Fischer & Porter Co.

■

31 Control Catalog

A new 68-page catalog of general purpose control devices, including a special section correlating by horsepower components for each type of motor control application has been announced by General Electric Co.'s general purpose control department. Designated GEC-1260A, the two-color publication contains photographs, book prices, wiring diagrams and dimensions.

General Electric Co.

32 Separator Catalog

Black, Sivalls & Bryson has published a 24-page catalog (30-01) on vertical separators. In addition to perspective, cutaway, and dimentional drawings for low, intermediate and high pressure sizes, the catalog features a section on sizing BS&B vertical separators.

Black, Sivalls & Bryson Inc.

■

33 Piston Ring Bulletin

C. Lee Cook Co. has issued Bulletin 500, a four-page publication covering the company's packing and piston rings. Descriptions of the company's three grades of laminated plastics are presented.

C. Lee Cook Co.

■

34 Service Booklet

Specific services and facilities offered to the utility power piping field, including fast, accurate methods of stress analysis, metallurgical research, new welding methods, and special heat treatment techniques, are described in a new 12-page booklet published by

CONCRETE RIVER WEIGHTS · SLEEVES · PIPE LINE HALF SOLES

COSTS AND PIPE HELD DOWN

One of the many Edwards Concrete River Weights installations on Texas-Illinois Natural Gas Pipeline.

Edwards Split Welding Sleeves also used on the line to insure perfect joints in swamps, rivers and safety zones.

A NEW SERVICE— ASK US ABOUT ON-THE-JOB MANUFACTURING OF CONCRETE RIVER WEIGHTS.

Allan Edwards, Inc.

PIPE LINE, REFINERY & GASOLINE PLANT EQUIPMENT ENGINEERS

2445 SOUTH JACKSON P.O. BOX 7218 TELEPHONES: 3-7184 — 3-7185 — 3-4287

Tulsa, Oklahoma

4-wheel drive does another job better!

BACKFILLING

Equipped with a hydraulically-controlled front-mounted dozer blade, the 4-wheel-drive Universal 'Jeep' is an efficient backfiller. Shown here is a blade mounted on a 'Jeep' trencher—thus creating a single power unit that does both trenching and backfilling. See your nearest Willys dealer or write for information.

4-WHEEL-DRIVE UNIVERSAL 'Jeep'®

A member of the 'Jeep' family...world's largest-selling 4-wheel-drive vehicles

Willys Motors, Inc., Toledo 1, Ohio

LONE STAR IS EQUIPPED TO HANDLE ANY SIZE PIPE PROJECT!

CROSS COUNTRY PIPE LINE CONSTRUCTION

PIPE LINE RIVER CROSSINGS

TAKING UP-RECONDITIONING OLD PIPE LINES

LONE STAR CONSTRUCTORS

Paul R. Halbert N. K. McFarland

OFFICE AND WAREHOUSE
10301 SHADY TRAIL
DALLAS 20, TEXAS PHONE FL7-2833

The Sign of Integrity

O. R. BURDEN Construction Corporation

TULSA, OKLAHOMA

O. R. Burden, President
P. T. Thibodaux, Vice-President
J. S. Burden, Vice-President

GENERAL PIPELINE CONSTRUCTION

P. O. Box 5216 • Phone 8-3378

trade literature • *Cont'd.*

the fabricated products division of M. W. Kellogg Co.

M. W. Kellogg Co.

■

35 Engine Bulletin

The 115- to 410-hp LeRoi L3000, H2000, and F1500 engines are described in a recently published bulletin. The eight-page, three-color bulletin uses cutaway views and photographs to show advanced features. Basic specifications are also include.

LeRoi Division

GAS progress reports

NEW CONSTRUCTION PLANNED

SOUTHERN COUNTIES GAS CO., Los Angeles. To build 31.5 miles of 30-in. line between Cactus City and Desert Center in Riverside county, Calif., to complete paralleling of the California-Texas pipeline system.

UNITED GAS PIPE LINE CO., Shreveport. Docket G-8230 for 68 miles of line and 330-hp station on system in Mississippi, Alabama, and Florida. Would drill 13 wells, build 7.3 miles of line, a dehydration plant, and additions to compressor stations to test facilities for underground storage.

WILCOX TREND GATHERING SYSTEM, Shreveport. To build 16-mile 16-in. loop line near Provident City, Texas; 2000-hp compressor station in Goliad county; add 2200 hp to existing station at Thomaston; and one 75-hp field compressor.

CURRENT CONSTRUCTION

ARKANSAS LOUISIANA GAS CO., Shreveport. Docket G-2307 for 134 miles of 6⅝- to 24-in. line in 11 sections, and 10,500-hp compressor station on its system in Arkansas, Louisiana, and Texas. Compressor station and 71 miles of line completed.

EAST OHIO GAS CO., Cleveland. A 113-mile, 30-in. pipeline to serve Cleveland area from point just south of Toledo. Construction started April 15.

EL PASO (TEXAS) NATURAL GAS CO. Docket G-2106 and G-2462 for 74 miles of line and 6925 additional hp on system in Texas, New Mexico, and Arizona. Should be completed by July 1.

LONE STAR GAS CO., Dallas. A 22-mile, 18-in. line from Farmers Branch, Texas to Collin county to supply Texas Power & Light Co. Scheduled for completion in June.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh. Docket G-2193 for 72 miles of 20- and 16-in. line, 38.7 miles of storage and well lines, 2 measuring stations and a 1760-hp compressor station at the Victory storage field in Marshall and Wetzel counties, W. Va.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh. Docket G-2289 for construction of 75½ miles of 10-, 12-, 24-, and 26-in. lines and 4400 in new and additional compressor facilities in Washington, Allegheny, Chester, Lancaster, and Adams counties, Pa., and Marshall county, W. Va.

MANUFACTURERS LIGHT & HEAT CO., Pittsburgh. Docket G-2479 for 61 miles of line and 1760 hp in compressor capacity on its system in Ohio, Pennsylvania, and West Virginia.

OHIO FUEL GAS CO., Columbus. Docket G-2522 880-hp compressor station under construction. Completion scheduled for May 15.

PACIFIC GAS & ELECTRIC CO., San Francisco. An 18-mile, 12-in. line in Colusa and Glenn counties to bring gas into Sacramento valley from two new fields. September completion.

PANHANDLE EASTERN PIPE LINE CO., Kansas City, Mo. Docket G-2433 for 575 miles of new line (294.6 miles approved), mainline loops, storage, lateral and gathering lines in Kansas, Missouri, Illinois, Indiana, Ohio, and Michigan and 113,000 hp in additional compression. Also includes development of Waverly storage field in Morgan county, Ill. Will increase peak-day delivery capacity from 970 to 1425 MMcf daily. Approved portion virtually completed. Balance awaits FPC approval.

SHENANDOAH GAS CO., Lynchburg, Va. Docket G-1448 for 39 miles of line from a point near Middletown, Va. to points near Winchester, Va. and Martinsburg, W. Va. Somerville Construction Co. scheduled to complete line this month. and Martinsburg, W. Va.

SOUTHEAST ALABAMA GAS DIST., Birmingham. A "U" shaped system of about 330 miles to serve 24 communities in southeastern Alabama from connections with Southern Natural. About 65% completed. Scheduled for completion in September.

TEXAS EASTERN TRANSMISSION CORP., Shreveport, and **NEW YORK STATE NATURAL GAS CORP.,** Pittsburgh. Docket G-2784 to construct field pipelines to connect up additional wells in Murrysville pool; acquire 2000-hp field gathering compressor station; and install 1980-hp station. New York State will operate facilities.

CONTRACTS LET

TEXAS GAS TRANSMISSION CORP., Owensboro, Ky. Docket G-6854 to lay 77.14 miles of partial loops in 7 sections between Covington, Tenn. to Jeffersontown, Ky.; 74 miles, 12-in., 35 miles 10-in., and 5 miles, 8-in. between Hardinsburg, Ky. compressor station and Columbus and Bedford, Ind.; 13.61 miles 20-in. loop near Haughton, La. compressor station; to consturct 26-in. crossings of Tennessee and Cumberland rivers in Kentucky and dual 12-in. crossings of Ohio river near Hardinsburg, Ky.; to build 4500-hp station at Riverton, La., and to add 400 hp at Greenville and Clarksburg, Miss.; 2000 hp at Lake Cormorant, Miss., and 1500 hp at Covington, Tenn. H. C. Price Co. to lay 26-, 12-, 10-, and 8-in. lines (except river crossings); Houston Contracting Co. to lay 20-in.; Pentzein Inc. to lay Cumberland and Tennessee river crossings.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston. Docket G-4185 for 360 miles of 36- and 30-In. line paralleling sections of system in nine states. Would include two river crossings; one 3000-hp and one 7500-hp station and miscellaneous additions to present stations. Contracts let to O. R. Burden Construction Corp., Associated Pipe Line Contractors Inc., Midwestern Constructors Inc., Houston Contracting Co., Western Constructors, Panama-Williams Co.

TRANSCONTINENTAL GAS PIPE LINE CORP., Houston. Docket G-2367 for 173 miles of 30- and 36-in. loops to parallel sections of existing system in Louisiana, Mississippi, Alabama, Georgia, North and South Carolina, Virginia, and Maryland, plus 46 miles of 12-in. and 16-in. loops and 12-mile, 24-in. extension of mainline in New Jersey. Contracts let to O. R. Burden Construction Corp., Midwestern Constructors Inc., Panama-Williams Co., Williams Brothers Co., and Associated Pipe Line Contractors Inc.

APPROVED

TEXAS EASTERN TRANSMISSION CORP., Shreveport. Docket G-2503 for 481 miles of line, 86,900 hp in new compressor stations, and 36,020 hp additions at existing stations—all to be located in Texas, Louisiana, Mississippi, Tennessee, Kentucky, Ohio, Pennsylvania, and Alabama. Project would include a 382-mile line from Beaumont, Texas, to Kosciusko, Miss.

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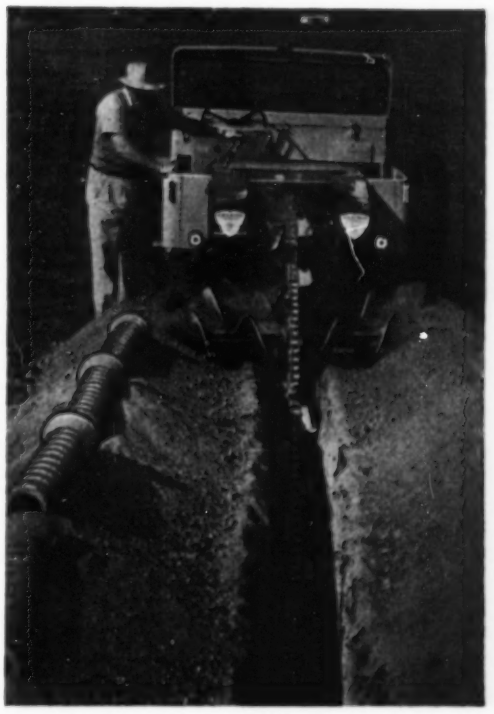

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